MITES ASSOCIATED WITH RODENTS IN ISRAEL

BY

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MITES ASSOCIATED WITH RODENTS IN ISRAEL

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INTRODUCTION

THE material forming the basis of this work was collected by the author during a survey of the parasites of wild mammals and birds in Israel. The survey was made possible by a grant from the National Institute of Health (U.S.A. Public Health Department) and was carried out under the direction of Prof. O. Theodor in the Dept. of Parasitology, the Hebrew University, Jerusalem.

Two papers have been published which deal partly with the acarine fauna of the area covered by the present study. Keegan (1956) in the " Laelaptid and Dermanyssid mites of Egypt, Kenya and the Sudan " deals with eleven of the twenty-four Israel species and subspecies, and Bregetova (1956), working in Russia, includes thirteen species of which six were also listed by Keegan. These numbers demonstrate the somewhat exceptional zoogeographical position of Israel on the limits of both the Ethiopian and the Palaearctic regions (Costa, 1958). A detailed discussion on zoogeography and host-specificity will be given elsewhere.

The classification follows closely Strandtmann & Wharton (1958) and therefore only the most important synonyms have been cited. Morphological terminology follows Evans (1957).

Types of the new species have been deposited at the British Museum (Natural History), paratypes have been deposited at the Hebrew University, Jerusalem (Dept. of Parasitology), and in the collections of the U.S. National Museum.

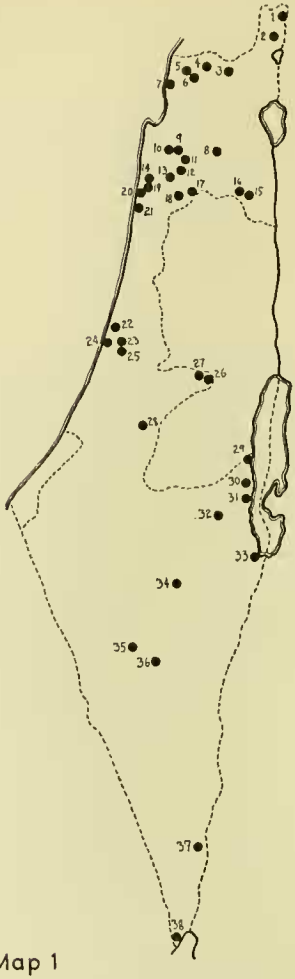
The localities in which the material has been collected are indicated in map 1.

MATERIALS AND METHODS

All the mites dealt with in this paper have been collected from trapped rodents in Israel. The living rodent was placed on a sheet of filter paper in a small transparent jar. It was anaesthetized with sulphuric ether. Most of the mites left the host immediately after the introduction of the ether and crawled on to the filter paper, the remainder were hand-collected from the fur. The rodents were kept alive for haematological and helminthological studies.

The mites were stored in small vials in 70% ethyl alcohol. The descriptions and the camera-lucida drawings were made from temporary mounts of lactic acid (Evans, 1957).

Measurements have been restricted to sclerotized structures which, with the possible exception of the length of the anal shield, are not affected by the degree of compression of the specimen.



Map 1

Map showing the localities in which collections of the material were made.

The spelling adopted here is as far as possible after *The Times Atlas of the World*, Mid-Century Edition, Vol. 11, Map 35. Edited by J. Bartholomew. London, 1959.

Aqua bella (27)
Akko Junction (10)
Beit Alfa (15)
Beit Guvrin (28)
Beit Hakerem (26)
Caesarea (21)
Dalia (13)
Dan (1)
Eyn Gedi (29)
Ha-Makhtesh Hagadol (34)
Holon (22)
Kabri (5)
Me'arat Karmel (19)
Mezada (31)
Mishmar Ha'emeq (12)
Nazareth (8)
Neoth Mordekhai (2)
Nes Ziona (25)
Nir David (16)
Palmahin (24)
Qishon (11)
Raman (36)
Rishon le Zion (23)
Rosh Zohar (32)
Sasa (3)
Sedom (33)
Shavey Zion (7)
Tivon (9)
Umm el Fahm (17)
Wadi Ara (18)
Wadi Masri (38)
Wadi Nafkh (35)
Wadi Seyal (30)
Yekhiam (6)
Yotvata (37)
Zikhron Ya'aocv (14)

HAEMOLAELAPS Berlese, 1910

Type : *Haemolaelaps marsupialis* Berlese, 1910.

A detailed examination of the chaetotaxy of the dorsum of the immature and adult stages of the Israel species of *Haemolaelaps* and *Laelaps* has shown that there is an overall chaetotactic pattern which is relatively constant and easily definable. The basic complement of setae in the adults appears to be 39 pairs, comprising 22 pairs on the " anterior dorsal shield " and 17 pairs on the "posterior dorsal shield ". The position of the setae is indicated by black dots in Text-fig. 1. The basic number may vary by the addition of one or two paired setae (*ax* and *px*1) or by the loss of one or two pairs (e.g. *s*3 or *px*3). The primary chaetotaxy is often supplemented by

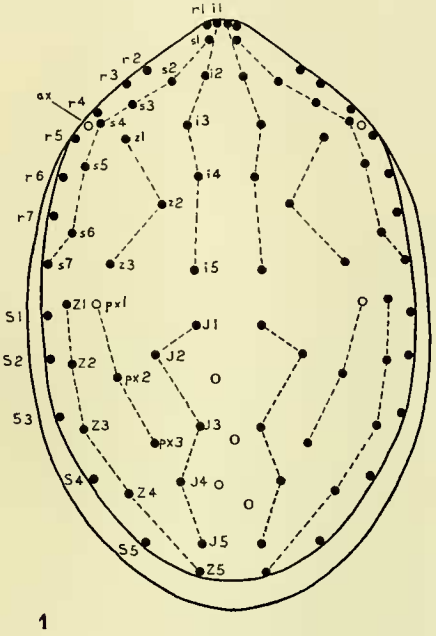


FIG. 1. Diagrammatic representation of the chaetotaxy of the dorsal shield in the genera *Haemolaelaps* and *Laelaps*.

unpaired accessory setae added at the deutonymphal stage (indicated by white circles in the diagram). These are usually restricted to the region between the J series, but they may extend over the greater part of the " posterior dorsal shield " and even over the " anterior dorsal shield ".

Although Bregetova (1956) has referred to " the strictly determined number of setae " on the dorsal shield, and has used a system of nomenclature designed to name all the setae, Hirschmann (1957) has been followed here in order to differentiate into the setae of the " anterior dorsal shield " and the " posterior dorsal shield ".

On the basis of the dorsal chaetotaxy the Israel material of *Haemolaelaps* may be divided into the following three groups :

1. Species with 39 paired dorsal setae : *H. glasgowi* (Ewing), *H. androgynus* Bregetova, *H. insculptus* Keegan, *H. ovalis* sp. nov. and *H. hirstionyssoides* sp. nov.

2. Species with 40 paired dorsal setae : *H. longipes* Breg.

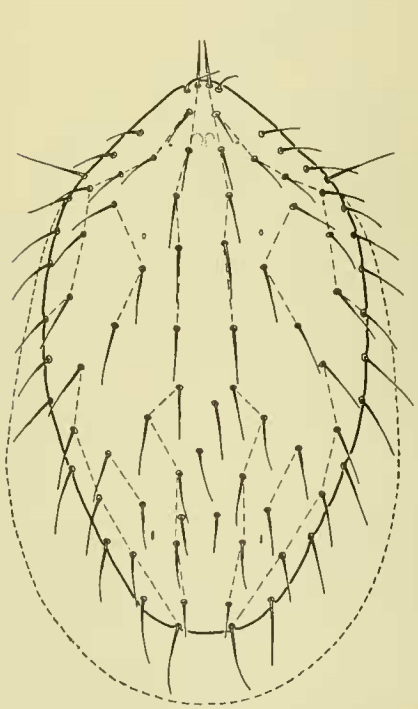
3. Species with 41 paired dorsal setae : *H. hirsti* Keegan and *H. centrocarpus* Berlese.

The males of the above-mentioned species may be also grouped according to the sclerotization of the venter ; species from gerbillids having the anal shield free while those from other hosts having the anal shield fused with the sternito-ventral shield This confirms the observations of Keegan (1956). *Haemolaelaps insculptus* Keegan is somewhat intermediate in character in having a large sternito-ventral shield abutting the anal shield.

Haemolaelaps androgynus Bregetova

Haemolaelaps androgynus Bregetova, 1952.

FEMALE (Text-figs. 2, 3). Dorsal shield 780–810 μ long and 465–495 μ wide. The



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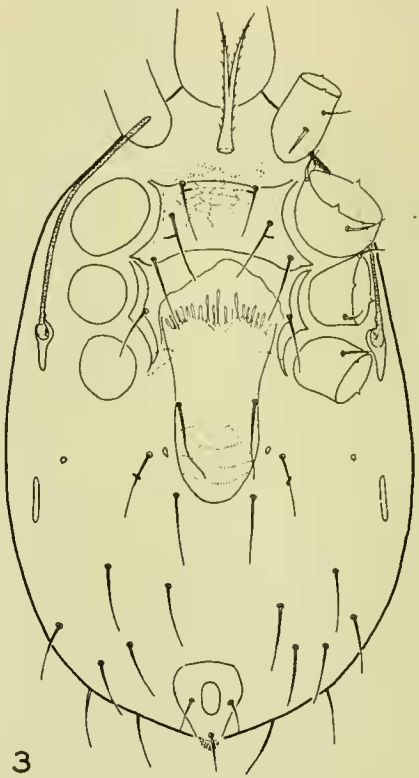

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FIGS. 2–3 *Haemolaelaps androgynus* Breg., female. Fig. 2, dorsal shield. Fig. 3, venter.

mites are rather weakly sclerotized, with the dorsal shield only faintly ornamented. The shield bears 39 pairs of symmetrical setae and a varying number of asymmetrical setae. The J5 setae are half the length or slightly shorter than the Z5 setae. The dorsal setae are distinctly shorter than the ventral setae. Distribution of setae and relative lengths of setae as in Text-fig. 2.

Tritosternum with long undivided base and feathered laciniae. The presternal area is sculptured but the anterior margin of the sternal shield is distinct. The anterior margin of the sternal shield is almost straight, its posterior margin is concave. The postero-lateral corners of the shield project distinctly between coxae II and III. The shield is 93–192 μ long (at mid-line) and 160–165 μ wide (at the level of the second setae), it is ornamented in its anterior part. The anterior pores are almost parallel to the anterior margin, the posterior pores have a slight outward slant. The anterior sternal setae are much shorter than the other sternal setae but longer than the metasternal setae. The weakly sclerotized genital shield is tongue-shaped and expands only slightly behind the genital setae, it is faintly marked with striations.

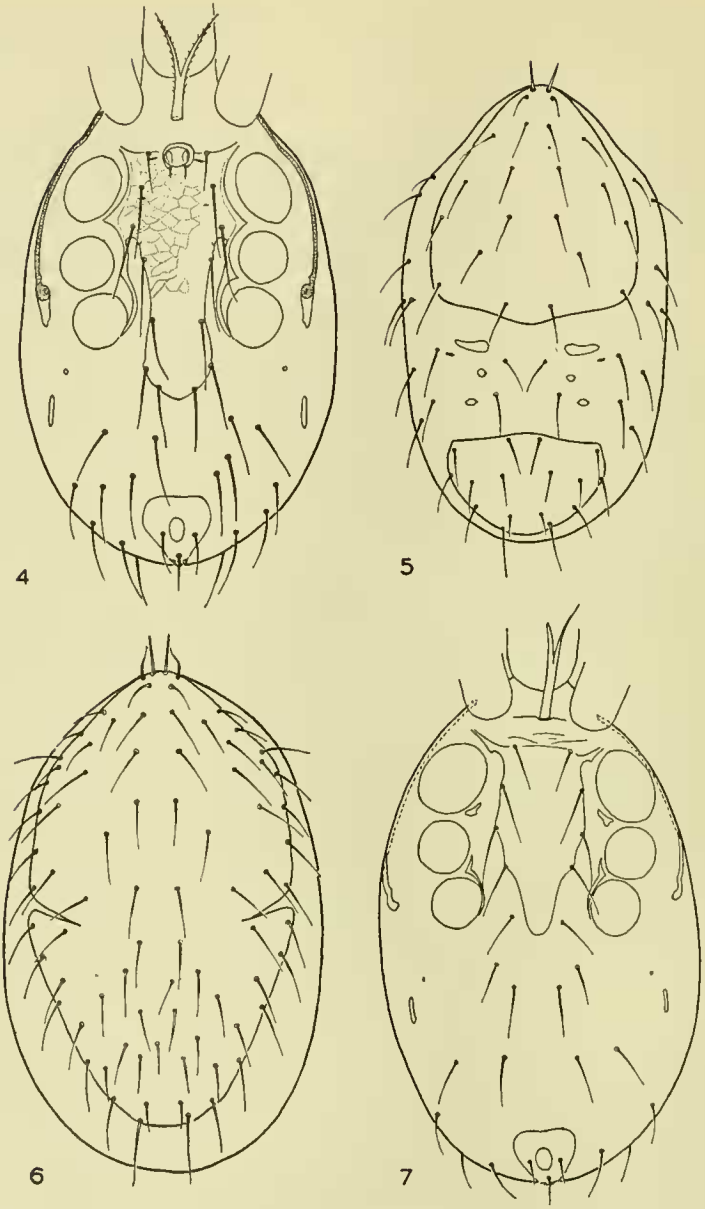
The metapodal shields are narrow and elongated. The anal shield is 145 μ long and 95 μ wide, the paranal setae, inserted near the posterior margin of the anus are slightly longer than the postanal seta. About 7 pairs of setae are inserted on the ventral integument. The peritreme reaches to the middle of coxa I, a peritrematal shield is present. The respective lengths of the legs (excluding pulvilli) are as follows: I—630 μ, II—570 μ, III—675 μ, IV—1, 020 μ.

Chelicerae chelate-dentate, pilus dentilis slightly inflated. The deutosternal teeth are in 6 rows, 3 teeth in each row. The internal posterior rostral setae are longer than the capitular setae and almost three times the length of the external posterior rostral setae. The corniculi are well sclerotized, horn-shaped and pointed.

Male (Text-fig. 4). Dorsal shield 615–630 μ long and 375–390 μ wide (in one male it is 550 μ long and 285 μ wide). The chaetotaxy of the dorsal shield is essentially the same as in the female, the setae are slightly longer. The anal shield is separate from the sternito-ventral shield. The sternito-ventral shield is tongue-shaped and behind the third pair of setae it is separated from the endopodal shields by membraneous integument. The shield bears 7 pairs of setae. The first pair of setae is rather short, only slightly longer than half the length of the third pair. The anal shield is approximately 95 μ long and 90 μ wide, the anus is nearer to the postanal seta than to the anterior margin of the shield. The paranal setae are inserted in line with the middle of the anus or slightly posterior to it, they are longer than the postanal seta.

Deutonymph (Text-figs. 6, 7). Dorsal shield 555–615 μ long and 315–375 μ wide. The sternal shield bears 4 pairs of setae and it is widest at the level of the third setae. The narrow part of the shield does not project behind coxa IV. The peritreme reaches beyond the posterior margin of coxa I.

Protonymph (Text-fig. 5). The anterior dorsal shield is 270–300 μ long and 225–240 μ wide. The sternal shield bears 3 pairs of setae, the third pair being the longest. The posterior margin of the shield forms an obtuse angle. There are 3 pairs of normal ventral setae and one pair of minute setae between coxae IV. The peritreme reaches almost to the anterior margin of coxa III.



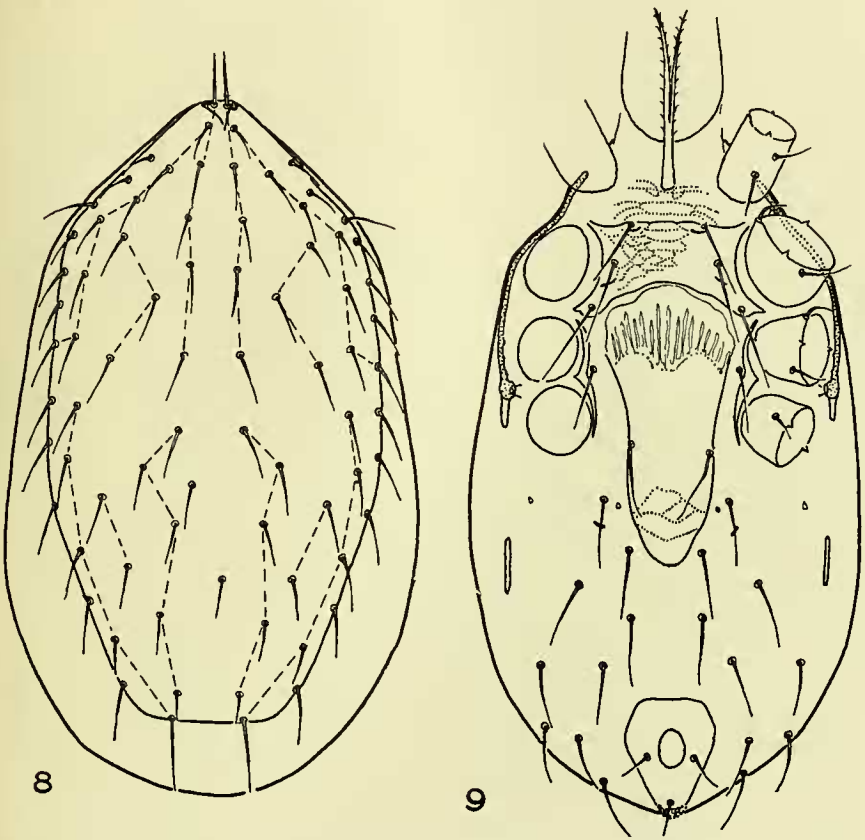
FIGS. 4–7. *Haemolaelaps androgynus* Breg. Fig. 4, venter of male. Fig. 5, dorsum of protonymph. Fig. 6, dorsal shield of deutonymph. Fig. 7, venter of deutonymph.

HOSTS AND LOCALITIES. All the specimens were taken off *Gerbillus* (*Dipodillus*) *dasyurus* at the following dates and localities : 4 pn, 1 dn—Ha-Makhtesh Hagadol, 26–xii.1954 ; 1 dn—ditto ; 1 pn, 2 dn, 4 ♀—Raman, 12.iv.1955 ; 2 pn, 22 dn, 11 ♂, 7 ♀—Wadi Masri, 16.iv.1955 ; 2 pn, 6 dn, 2 ♂—ditto ; 1 ♀, Umm el Fahm, 18.viii.1955.

NOTES. The Israel material differs slightly in the measurements from those given by Bregetova (1956) and in the form of the dorsal shield which is less ovoid in shape. Only one female (the specimen from Umm el Fahn) has comparable dimensions, the dorsal shield measuring 690 μ long and 450 μ wide. Its sternal shield is only 80 μ long. The dorsal shield in this specimen is rounder than in the other specimens and it bears no asymmetrical setae.

Haemolaelaps androgynus caluri ssp. nov.

FEMALE (Text-figs. 8, 9). Dorsal shield 645–735 μ long and 330–420 μ wide. The



FIGS. 8–9. *Haemolaelaps androgynus caluri* ssp. nov., female.
Fig. 8, dorsal shield. Fig. 9, venter.

lateral margins of the posterior part of the shield are convergent. The posterior end of the shield is markedly truncated. The dorsal setae are shorter than the ventral setae. The shield bears 39 pairs of symmetrical setae, many specimens (about 50%) have in addition one or more asymmetrical setae. The mites are only weakly sclerotized.

Tritosternum with long shaft and feathered laciniae. The presternal area is faintly ornamented. The sternal shield is 54–64 μ long (at mid-line) and 134–147 μ wide (at level of second setae), the shorter shields being the widest. The anterior margin of the shield is practically straight, the posterior margin is rather deeply concave. The postero-lateral corners of the shield project between coxae II and III. The pores are very distinct, slightly crescent-shaped and almost parallel to the anterior and the posterior margins of the shield respectively. The shield is ornamented with fine striations. The sternal setae are simple and elongated, the first setae are longer than the sternal shield. The metasternal setae are only slightly shorter than the first sternal setae, about two-thirds of the third sternal setae.

The genital shield is tongue-shaped and narrow, it is ornamented with faint striations. The metapodal shields are very narrow and elongated. Approximately 8–9 pairs of long setae are inserted on the ventral integument. The anal shield is 102–118 μ long and 80–96 μ wide. The paranal setae are slightly longer than the postanal seta, they are inserted near the posterior margin of the anus. The peritreme reaches slightly beyond the middle of coxa I. A small peritrematal shield is present.

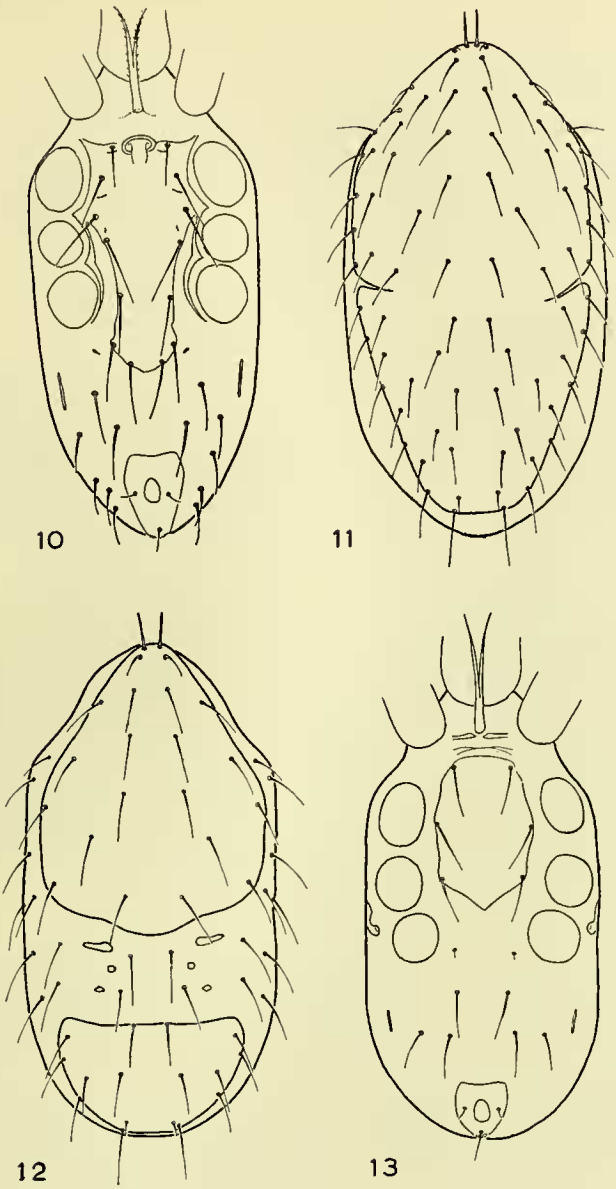
The respective lengths of legs (excluding pulvilli) are as follows: I—480 μ; II—420 μ; III—465 μ; IV—675 μ. Chelicerae chelate-dentate, pilus dentilis slightly inflated. The deutosternal teeth are arranged in 6 rows, mainly 4 teeth in each row. The internal posterior rostral setae are long, longer than the capitular setae.

Male (Text-fig. 10). Dorsal shield 480–540 μ long and 255–300 μ wide. Chaetotaxy essentially the same as in the female. The anal shield is separate from the sternito-ventral shield which bears 7 pairs of setae. The sternito-ventral shield is tongue-shaped, behind the third pair of setae it is separated from the endopodal shields by a strip of membraneous integument as in *H. androgynus*. The anal shield is 90–97 μ long and 67 μ wide. The peritreme reaches beyond the posterior margin of coxa I.

Deutonymph (Text-fig. 11). Dorsal shield 480–540 μ long and 225–300 μ wide. Chaetotaxy as in female. The sternal shield bears 4 pairs of setae and it projects slightly beyond coxae IV. The peritreme reaches to the middle of coxa I. Approximately 11 pairs of ventral setae are inserted on the ventral integument.

Protonymph (Text-figs. 12, 13). Anterior dorsal shield 230 μ long and 190 μ wide. The sternal shield is widest at the second pair of setae, the posterior margin of the shield forms an obtuse angle. Three pairs of normal ventral setae and one pair of minute setae between coxae IV are inserted on the ventral integument. The peritreme reaches to the middle of coxa III.

Hosts and localities. All specimens were recovered from *Sekeetamys calurus* at the following localities and dates: 3 dn, 7 ♀—Raman, 25.x.1954; 6 pn, 4 dn, 1 ♂, 4 ♀—Wadi Masri, 16.iv.1955; 2 pn, 2 dn, 1 ♂, 2 ♀—ditto; 2 ♂—ditto; 3 pn, 6 dn,



FIGS. 10–13. *Haemolaelaps androgynus caluri* ssp. Fig. 10, venter of male. Fig. 11, dorsal shield of deutonymph. Fig. 12, dorsum of protonymph. Fig. 13, venter of protonymph.

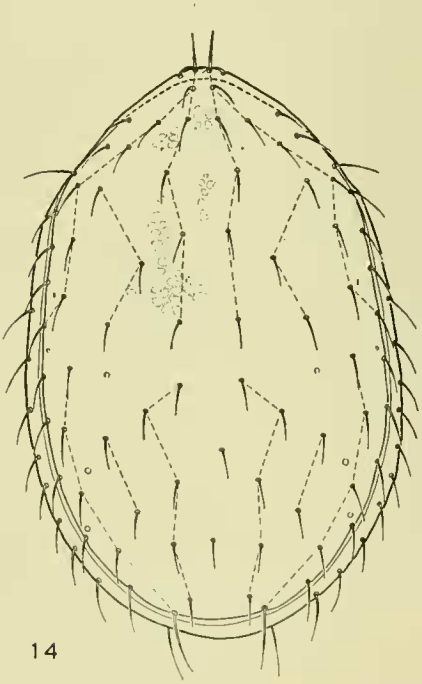
6 ♂—ditto ; 2 pn, 5 dn, 6 ♂, 4 ♀—ditto, 1.xi.1955 ; 1 pn, 8 dn, 11 ♂, 10 ♀—ditto, 5.xii.1955 ; 6 pn, 9 dn, 11 ♀—ditto ; 3 ♂, 8 ♀— Mezada, 29.ii.1956 ; 9 pn, 10 dn, 5 ♂, 9 ♀—ditto.

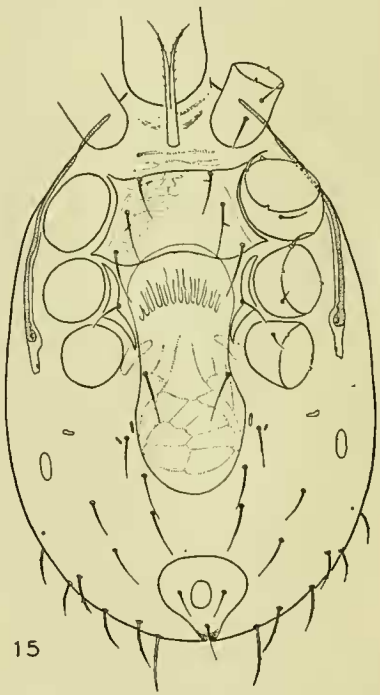
NOTES. The form found on *Sekeetamys calurus* differs from *Haemolaelaps androgynus* in the following constant features : it is much smaller without any overlapping of size, its dorsal shield is more truncated, its sternal shield is much shorter (relatively to its width as well as absolutely) and the first sternal setae are longer. As these features are mainly ones of degree, the forms occurring on *Sekectamys calurus* are considered as a new subspecies.

Haemolaelaps glasgowi (Ewing)

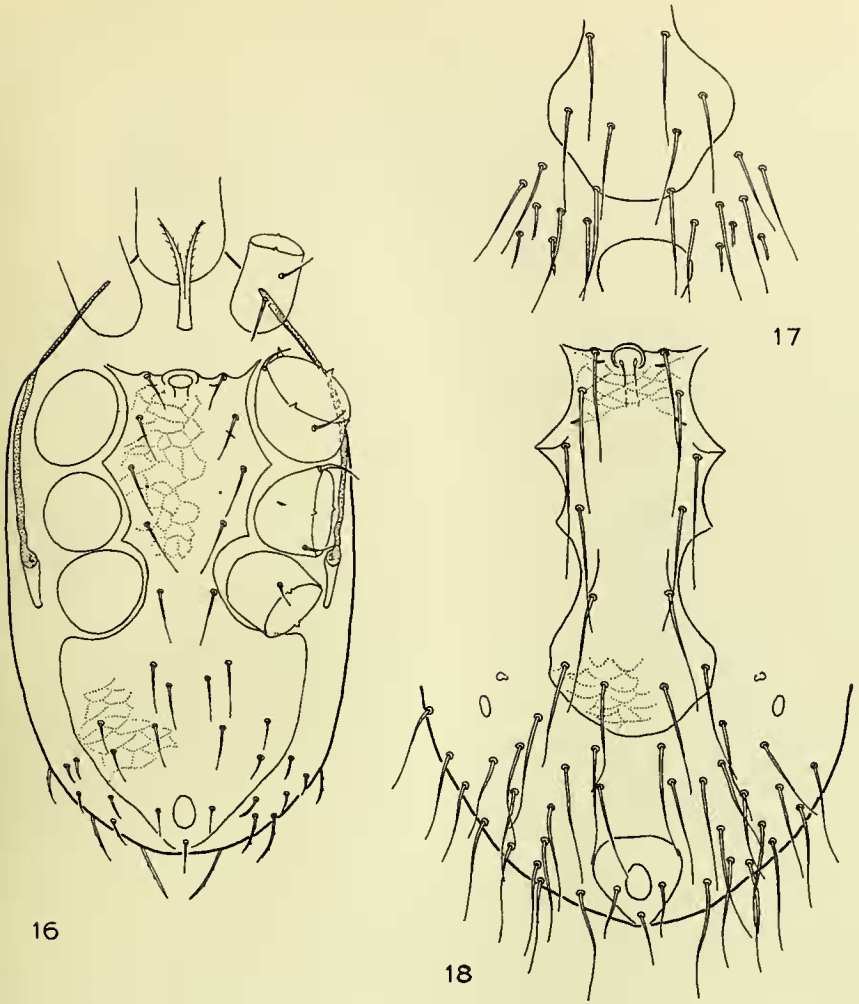
Laelaps glasgowi Ewing, 1925.
Atricholaelaps glasgowi, Wharton, 1938.
Haemolaelaps glasgowi, Strandtmann, 1949.

FEMALE (Text-figs. 14, 15). The dorsal shield is oval, it is 675–720 μ long and 435–480 μ wide. The shield is sculptured on its anterior part and is ornamented with striations throughout. On the shield are a number of pores, 2 pairs of pores near the postero-lateral margin of the dorsal shield are especially prominent. The shield





FIGS. 14–15. *Haemolaelaps glasgowi* (Ewing,) female. Fig. 14, dorsum. Fig. 15, venter.



FIGS. 16–18. Fig. 16, *Haemolaelaps glasgowi* (Ewing), venter of male. Figs. 17–18, *Haemolaelaps hirsti* Keegan, venter of the male, showing variation in the outline of the sterniti-ventral shield.

bears 39 pairs of simple setae which are shorter than the smooth ventral setae, a varying number of asymmetrical setae may also be present. The shield has a distinct double border, the marginal setae are inserted on the inner margin.

The tritosternum is distinct and its laciniae are well feathered. The presternal area is faintly ornamented and the anterior margin of the sternal shield is well defined. The sternal shield is 93–109 μ long (at mid-line) and 144–157 μ wide (at the level of the second sternal setae). The anterior margin is only slightly convex, the posterior

margin is concave and weakly emarginate. The shield is ornamented throughout with striations. The anterior pores are parallel to the anterior margin, the posterior pores have an outward slant. The sternal setae are short, even the second setae barely project beyond the posterior margin of the sternal shield. The metasternal setae are only slightly shorter than the first sternal setae.

The genital shield is tongue-shaped, it is expanded behind the genital setae. The shield bears one pair of simple setae and it is ornamented with striations. The anal shield is pear-shaped, it is 96–100 μ long and 105–118 μ wide. The paranal setae are inserted in line with the middle of the anus. The metapodal shields are elongate-oval. Five pairs of simple setae are inserted on the ventral integument, as well as a number of latero-ventral setae which are barbed, mainly on their outer curvature. The peritreme reaches slightly beyond the middle of coxa I.

The coxae are rather short and stumpy, the respective lengths of the legs (excluding pulvilli) are as follows: I—570 μ; II—480 μ; III—495 μ; IV—675 μ. The chelicerae are chelate-dentate, the pilus dentilis on the fixed finger is highly inflated in its proximal part, its terminal portion is slender and recurved.

Male (Text-fig. 16). The dorsal shield is 540–585 μ long and 300–315 μ wide. The shape and the chaetotaxy of the dorsal shield are essentially the same as in the female. The holoventral shield bears 23 setae (including the anal setae); it is ornamented with striations throughout. The shield expands behind coxae IV, it includes the metapodal shields. Many of the setae that are inserted on the postero-lateral integument are barbed on their outer curvature. The spermatophoral process of the movable finger is extremely long and its distal portion is recurved.

Hosts and localities. All specimens were recovered from *Microtus guentheri* at the following dates and localities: 1 ♀—Mishmar Ha'emeq, 10.i.1953; 12 ♀—ditto, 14.v.1955; 1 ♀—Neoth Mordekhai, 20.v.1955; 3 ♂—Mishmar Ha'emeq, 23.xii.1955 (out of nest material).

Notes. Strandtmann & Wharton (1958) have already pointed out that this widespread mite represents a species complex. No attempt will be made here to deal with the complex as a whole, although the following points should be mentioned: Bregetova (1956) states that *Haemolaelaps glasgowi* has only 38 pairs of dorsal setae (setae *s3* are missing). Females from Japan (*ex Rattus norvegicus*) in the collection of the British Museum are identical with the females from Astrakhan. In the Israel material, the females have 39 pairs of dorsal setae as well as a number of asymmetrical setae on the posterior dorsal shield. Specimens from South Africa (examined by the courtesy of Dr. W. Till) have the same chaetotaxy as the material from Israel although in most specimens the dorsal setae are more elongated.

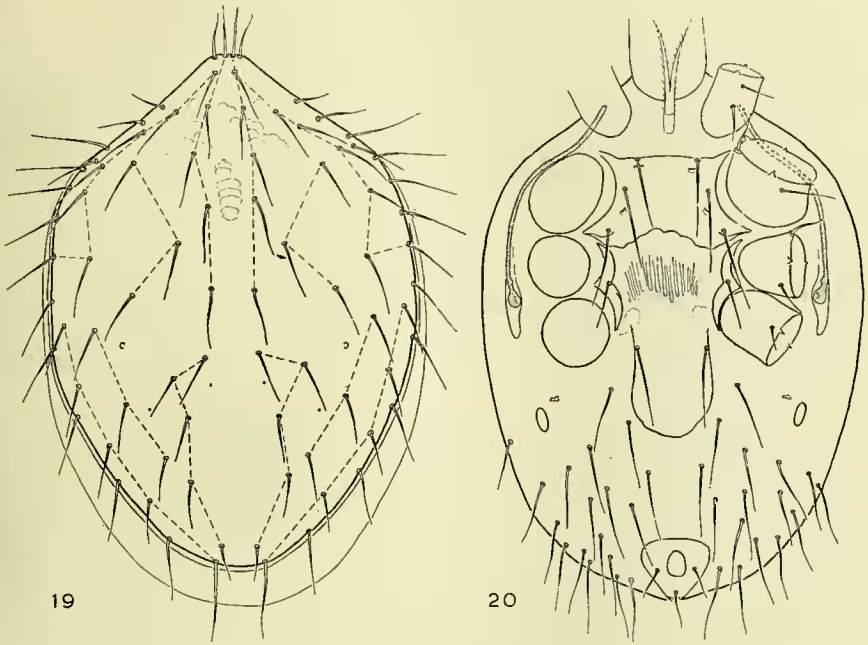
Haemolaelaps hirsti Keegan

Haemolaelaps hirsti Keegan, 1956.

Female (Text-figs. 19, 20). Dorsal shield oval, it is 1,125–1,215 μ long and 810–855 μ wide. The shield bears 41 pairs of setae (*ax* and *px*1 in addition to the normal 39 pairs). The setae on the posterior half of the shield are distinctly shorter than the ventral setae. Some of the setae, mainly the postero-marginal ones, may be slightly

barbed. Setae J5 are less than half the length of setae Z5. The shield has a distinct double margin and it is well sculptured, mainly on its anterior part.

The tritosternum is very distinct and its laciniae are feathered. The presternal area is ornamented and the anterior margin of the sternal shield may be indistinct. The sternal shield is 150–180 μ long (at mid-line) and 225–250 μ wide (at the level of the second setae). The anterior margin is practically straight, the posterior margin is markedly concave and emarginate in various degrees. The anterior pores are



FIGS. 19–20. *Haemolaelaps hirsti* Keegan, female. Fig. 19, dorsum. Fig. 20, venter.

parallel to the anterior margin of the shield, the posterior pores have a distinct outward slant. The shield is only very faintly ornamented and its surface seems to be granulated. The sternal setae are very long, the first setae are only slightly shorter than the second and third setae which are of equal length. The metasternal setae are slightly less than half the length of the third sternal setae.

The genital shield is only weakly sclerotized, it does not expand posteriorly to the genital setae. The genital setae are elongated and may almost reach the posterior margin of the shield. The metapodal shields are elongate-oval. The anal shield is fairly triangular, it is 173–183 μ long and 160–173 μ wide. The paranal setae are usually of the same length as the postanal seta, in some specimens they appear to be longer. The number of setae inserted on the ventral membrane is 17–20 pairs (it may be higher in more compressed specimens), some of the setae, mainly the postero-

lateral ones, are slightly barbed. The peritrene reaches to the middle of coxa I, a peritrematal shield is present.

Of the two ventral setae on coxa I, the proximal seta is distinctly longer and stouter than the distal seta. On femur I are 2 well-developed dorsal, spur-like setae and a smaller dorsal, spur-like seta on trochanter I. The respective lengths of the legs (excluding pulvilli) are as follows : I—990 μ ; II—900 μ ; III—1,005 μ ; IV—1,200 μ. Chelicerae chelate-dentate, pilus dentilis not inflated, with a curved tip. The deutosternal teeth are arranged in 6 rows, 4–6 teeth in each row.

Male (Text-figs. 17, 18). Dorsal shield 990–1,020 μ long and 675–705 μ wide. The chaetotaxy is essentially the same as in the female. The anal shield is separate from the sternito-ventral shield which bears 7–8 pairs of long (160–205 μ) setae. The shape of the posterior margin of the shield is variable (Text-figs. 17, 18) and therefore a certain variation can be found in the number of setae it bears and in its distance from the anal shield. The shield may be faintly ornamented, mainly in its anterior and posterior portions. The chelicerae bear elongated spermatophoral processes.

Deutonymph. The dorsal shield has distinct lateral incisions, it is 900 μ long and 630 μ wide. The chaetotaxy is as in the female. The sternal shield is broadest mid-way between the second and the third sternal setae, its hind end does not reach as far as the posterior margin of coxae IV. Four pairs of simple setae are inserted on the shield. Approximately 15 pairs of setae are inserted on the ventral integument, the posterior ones are slightly barbed.

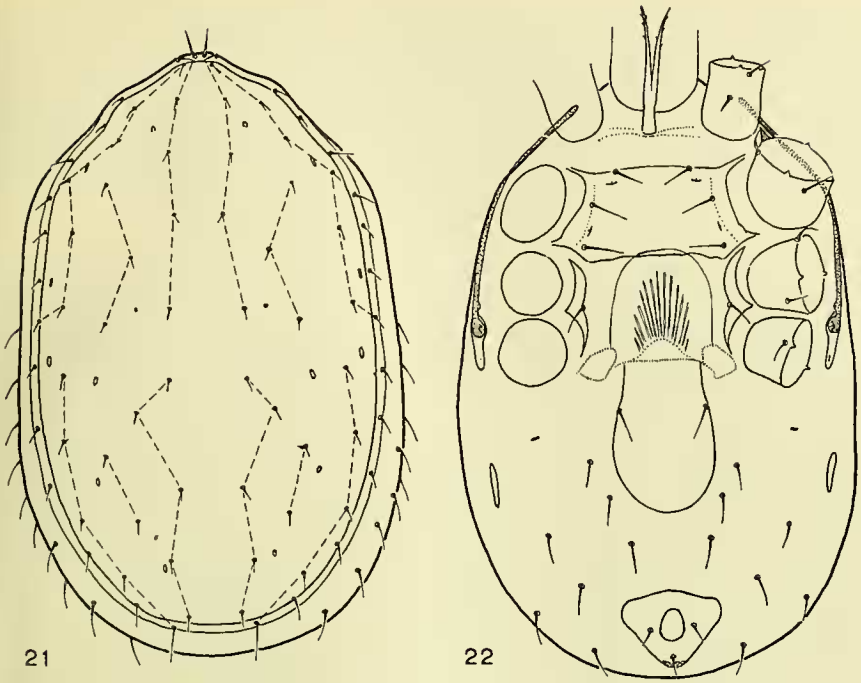
Protonymph. The anterior dorsal shield is 420 μ long and 400 μ wide, it bears 11 pairs of fairly long setae. The setae of the posterior row on the pygidial shield are longer than the other setae on the shield, they are slightly barbed. The sternal shield is broadest at the level of the second setae and it is ornamented throughout. Four to five pairs of real ventral setae and a pair of minute setae between coxae IV are inserted on the ventral integument. Three to four pairs of postero-lateral setae may be slightly barbed.

Hosts and localities. 7 ♂, 10 ♀—*Gerbillus allenbyi*, Caesarea, 23.vii.1954 ; 1 ♂, 10 ♀—ditto ; 5 ♂, 8 ♀—ditto ; 3 ♂, 2 ♀—ditto ; 2 ♂, 3 ♀—Ma'agan Mikhael, 26.ix.1955 ; 1 ♀—ditto ; 5 pn, 5 dn, 8 ♂, 16 ♀—Rishon le Zion (Dunes).

Notes. This species has been determined by comparison with a paratype female in the collection of the British Museum (N.H.). Keegan (1956) described a similar species, *Haemolaelaps ewingi* from *Gerbillus gerbillus* basing the differences mainly on the relative length of the sternal shield and on the length of the genital setae. As these differences are in rather variable characters, it may be possible that these two species are in fact synonymous. This conclusion has been reached on purely zoogeographical speculations, unfortunately no specimens of *H. ewingi* were available at the time of the study.

Haemolaelaps hirstionyssoides sp. nov.

Female (Text-figs. 21, 22). The dorsal shield is ovoid with well-developed shoulders it is broadest posterior to coxae IV. The shield is 555–585 μ long and 330–375 μ wide. The shield bears 39 pairs of very minute setae (some of them can be seen clearly only with high magnification). The shield may be faintly ornamented on its anterior



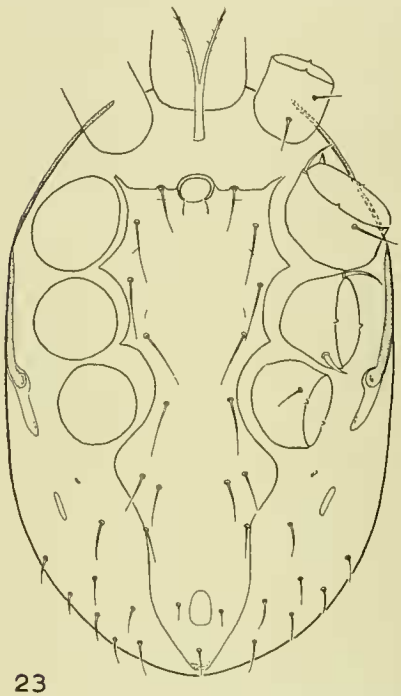
FIGS. 21–22. *Haemolaelaps hirstionyssoides* sp. nov., female. Fig. 21, dorsum. Fig. 22, venter.

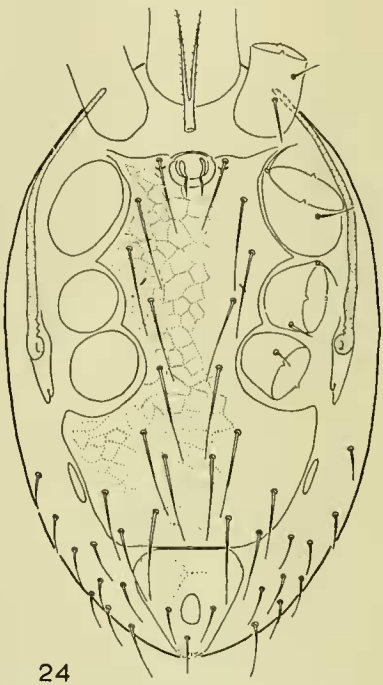
part and it has many distinct pores. The dorsal shield has a double border, consisting of a thinner marginal stripe on which most of the marginal setae are inserted.

The tritosternum is rather translucent, the laciniae are only sparsely feathered. The sternal shield is 86–93 μ long (at mid-line) and 130–140 μ wide (at the level of the second setae), its anterior margin is rather indistinct and slightly convex, its posterior margin is almost straight, weakly emarginate and irregular. The shield is granulated throughout, without any other ornamentation. The sternal setae are extremely short, even the second sternal setae do not reach the posterior margin of the shield. The metasternal setae are of the same length as the sternal setae. The anterior pores are parallel to the anterior margin, the posterior pores are almost parallel to the lateral borders of the shield.

The genital shield is tongue-shaped and rather rounded, it surface is granulated throughout. The shield bears one pair of short genital setae. The anal shield is 80–85 μ long and 90–93 μ wide. The anus is nearer to the postanal seta than to the anterior margin of the shield. The paranal setae are inserted in line with the middle of the anus. The anal setae are very short. The metapodal shields are narrow and elongated. Five pairs of smooth setae are inserted on the ventral integument. The setae of the postero-lateral integument are weakly barbed on their outer curvature.

The proximal seta on coxa I is stouter and shorter than the distal seta. Coxa II has a distinct sharp spine on its antero-dorsal rim. The legs are rather stumpy and short, their respective lengths (excluding pulvilli) are as follows : I—495 μ ; II—360 μ ; III—360 μ ; IV—435 μ. Leg II is much stouter than the other legs. Chelicerae chelate-dentate, the movable finger is rather curved, the pilus dentilis is hair-like. The deutosternal teeth are in 6 rows, 2–4 teeth in each row. The gnathosomal setae are short, the internal posterior rostral setae being the longest.





FIGS. 23–24. Fig. 23, venter of male of *Haemolaelaps hirstionyssoides* sp. nov. Fig. 24, venter of male of *Haemolaelaps insculptus* Keegan.

MALE (Text-fig. 23). The dorsal shield is 450–465 μ long and 300–315 μ wide. The chaetotaxy of the dorsal shield is essentially as in the female. The rather narrow holoventral shield bears 19 setae, including the anal setae. The first 5 pairs of setae are distinctly longer and stouter than the other setae on the shield. The holoventral shield is granulated almost throughout, the area occupied by the anal shield is faintly ornamented with striations. The peritreme reaches slightly beyond the middle of coxa I. The postero-ventral seta on coxa III is very stout. The legs are rather short and stumpy.

HOSTS AND LOCALITIES. 1 ♂, 44 ♀—*Spalax ehrenbergi*, Zikhron Ya'aqov, 8.iv.1954; 1 ♂, 1 ♀—ditto, Beit Hakerem, 21.xii.1952 ; 1 ♀—*Mus musculus*, Akko. Junction, 22.ii.1956.

NOTES. This species is rather interesting in having the habitus of a *Hirstionyssus*. Superficially one is inclined to consider this to be a *Hirstionyssus* without coxal spurs, for the following reasons : granulated surface of the ventral shields, narrow holoventral shield of male, short and stumpy legs. However, the character of the deutosternal teeth as well as the chelate-dentate chelicerae indicate clearly the position of this species. *Haemolaelaps hirstionyssoides* seems to be most closely related to *Haemolaelaps glasgowi*.

Haemolaelaps insculptus Keegan

Haemolaelaps insculptus Keegan, 1956.

FEMALE (Text-figs. 25, 26). The dorsal shield is oval, it is 600–690 μ long and 420–465 μ wide. The shield is heavily sclerotized and sculptured. Thirty-nine pairs of setae are inserted on the dorsal shield. The dorsal setae are markedly shorter than the ventral setae. Some of the setae, mainly the marginal ones, are slightly barbed. Setae J5 are approximately half the length of setae Z5.

Tritosternum with long shaft and feathered laciniae. The distance between the base of the tritosternum and the anterior margin of the sternal shield is very narrow. The sternal shield is 110 μ long (at mid-line) and 145–150 μ wide (at the level of the second setae). The shield is heavily sclerotized and markedly sculptured on its anterior part. The anterior margin is straight between the bases of the first pair of setae, the posterior margin is concave. The sternal setae are long, but the setae of the first pair do not reach the posterior margin of the shield. The short metasternal setae are inserted on well-sclerotized endopodal shields which are attached to the sternal shield. The length of the metasternal setae is approximately one-third of the length of the third sternal setae.

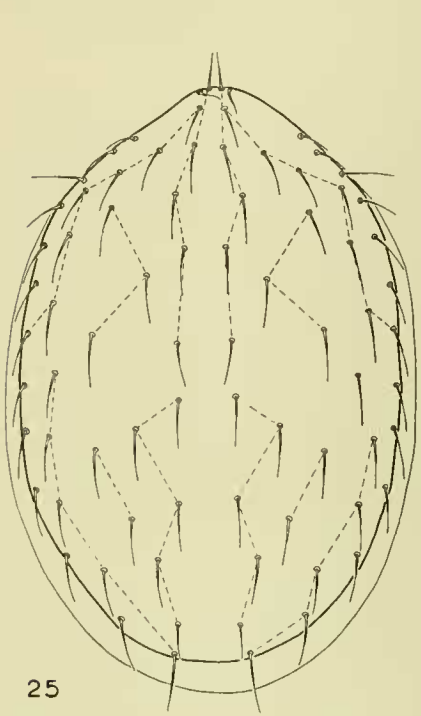
The genital shield is broadest immediately behind the genital setae, it is well marked with striations. Only one pair of setae is inserted between the genital and the anal shields. The length of the long ventral setae is approximately 85–90 μ, the posterior setae may be slightly barbed. The metapodal shields are elongated and narrow. The anal shield is 112 μ long and 112 μ wide, its anterior margin is almost straight, with rounded corners. The distance of the anus from the anterior margin of the anal shield is much greater than the length of the anus. The paranal setae are usually inserted on a line slightly anterior to the middle of the anus, their length roughly equals the length of the postanal seta. The anal shield is ornamented. The peritreme reaches slightly beyond the posterior margin of coxa I, a peritrematal shield is present.

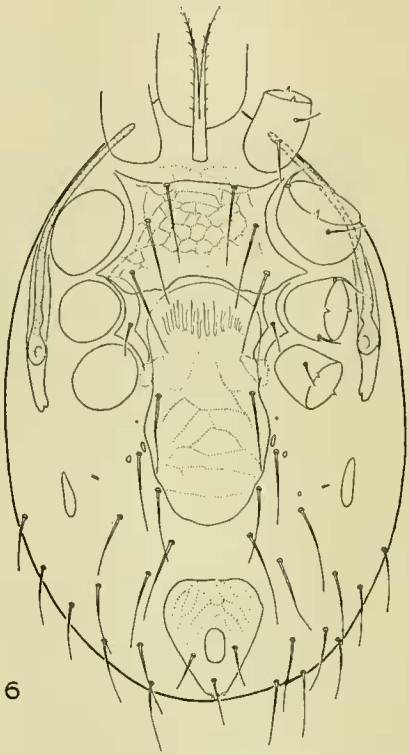
The coxae are ornamented. Of the two ventral setae on coxa I, the proximal seta is markedly larger and stouter than the distal seta. The respective lengths of the legs (excluding pulvilli) are as follows : I—445 μ ; II—435 μ ; III—435 μ ; IV—630 μ. Most of the setae on tarsus and tibia II are thick and spine-like.

Chelicerae chelate-dentate, the pilus dentilis is only slightly inflated. The deutosternal teeth are arranged in 6 rows of 3 (rarely 4) teeth.

MALE (Text-fig. 24). The males are markedly smaller than the females. The dorsal shield is 450–480 μ long and 255–270 μ wide. The chaetotaxy of the dorsal shield is

essentially the same as in the female. The anal shield is separated from the sternito-ventral shield. The sternito-ventral shield is markedly sculptured throughout and it bears 10 pairs of long setae. It is broadest immediately behind coxa IV and reaches to the anterior margin of the anal shield. The metapodal shields and the anal shield are as in the female. Setae on tarsus II thick and spine-like as in the female.





FIGS. 25–26. *Haemolaelaps insculptus* Keegan, female. Fig. 25, dorsal shield. Fig. 26, venter

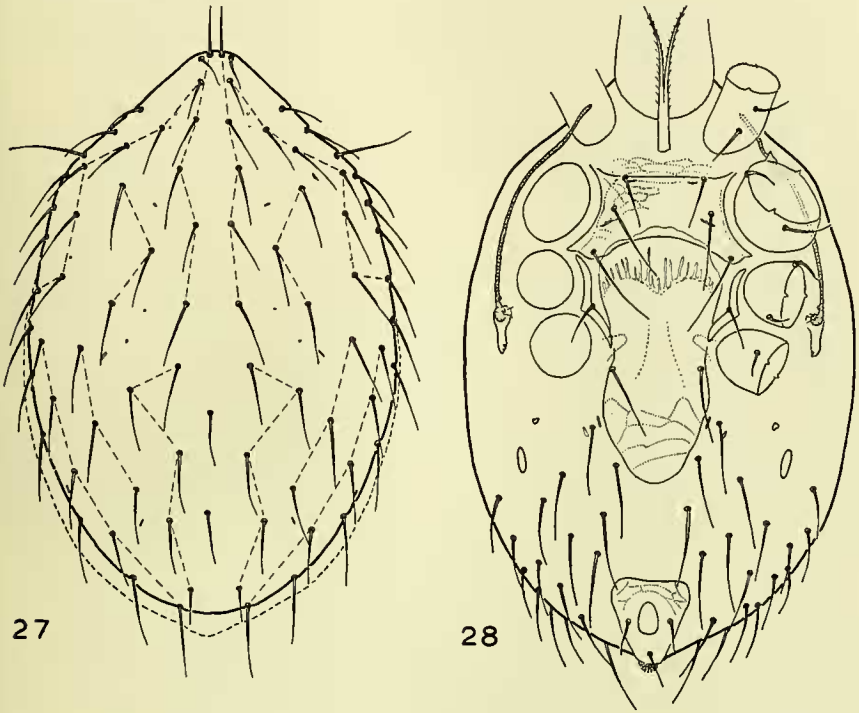
HOSTS AND LOCALITIES. 6 ♂, 3 ♀—*Gerbillus pyramidum*, Holon, 12.vii.1954; 1 ♀—*Gerbillus allenbyi*, Holon, 12.vii.1954; 1 ♂, 2 ♀—*G. pyramidum*, Holon, 2.ix.1954; 3 ♀—ditto; 1 ♂, 1 ♀—*G. allenbyi*, Ma'agan Mikhael, 26.ix.1955; 2 ♀—ditto; 4 ♂, 16 ♀—*G. pyramidum*, Rishon le Zion (Dunes); 4 ♂, 12 ♀—*Meriones sacramenti*, Rishon le Zion (dunes); 3 ♂, 11 ♀—ditto.

NOTES. This species was previously known only from Egypt. According to the distribution of its hosts, our area might well be on the northern limit of the distribution of the species. The material from Israel differs somewhat from the typical material, mainly in being larger, but the mites are undoubtedly conspecific.

Haemolaelaps longipes Bregetova

Haemolaelaps longipes Bregetova, 1952.
Haemolaelaps aegyptius Keegan, 1956 *syn. nov.*

Female (Text-figs. 27, 28). The dorsal shield is ovoid, it is 855–900 μ long and 570–600 μ wide. The shield bears 40 pairs of setae (the additional pair is *px*1) as well as some asymmetrical setae. The dorsal setae are only slightly shorter than the ventral setae. Setae J5 slightly over half the length of setae Z5.



Figs. 27–28. *Haemolaelaps longipes* Breg., female. Fig. 27, dorsal shield. Fig. 28, venter.

Tritosternum with long shaft and feathered laciniae, relatively weakly sclerotized. The presternal area is ornamented but the anterior margin of the sternal shield is usually well defined. The sternal shield is 85–110 μ long (at mid-line) and 192–202 μ wide (at the level of the second setae). The anterior margin between the first sternal setae is straight, the posterior margin is concave. The sternal setae are very long, the metasternal setae are slightly longer than half the length of the third sternal setae. The sternal shield, although only weakly sclerotized, is sculptured on its anterior two-thirds. The pores are slightly crescent-shaped, the anterior pores are parallel to the anterior margin, the posterior pores have a slight outward slant.

The genital shield is weakly sclerotized but ornamented with striations ; it is widest behind the genital setae. The shield is flanked by two pairs of setae, it is constricted and narrowing just opposite the posterior flanking setae. The anal shield is 145 μ long and 122–128 μ wide. The paranal setae are inserted slightly posterior to the middle of the anus, they are slightly longer than the postanal seta. The metapodal shields are very narrow and elongated. Fifteen to sixteen pairs of setae are inserted on the ventral integument. The tubular part of the peritreme reaches slightly beyond the middle of coxa I ; a peritrematal shield is present.

The two ventral setae on coxa I are of subequal length, the proximal seta is much stouter than the distal seta. All coxae are slightly sculptured. The respective lengths of the legs (excluding pulvilli) are as follows : I—795 μ ; II—705 μ ; III—780 μ ; IV—1,065 μ.

Chelicerae chelate-dentate. The pilus dentilis on the fixed finger is only slightly inflated. The internal posterior rostral setae are very long (approximately 95 μ), longer than the capitular setae, almost three times the length of the outer posteror rostral setae. The deutosternal teeth are arranged in 6 rows, 4–5 teeth in each row.

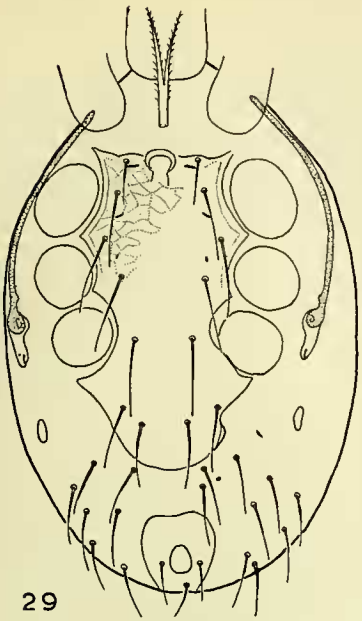
Male (Text-fig. 29). The dorsal shield is 570 μ long and 390 μ wide. The chaetotaxy of the dorsal shield is essentially the same as in the female. The anal shield is separate from the sternito-ventral shield. The sternito-ventral shield bears 7 pairs of long setae of which the first pair is the shortest. The shield although only weakly sclerotized, is ornamented throughout with striations. The paranal setae are slightly longer than the postanal seta. The peritreme reaches to the middle of coxa I.

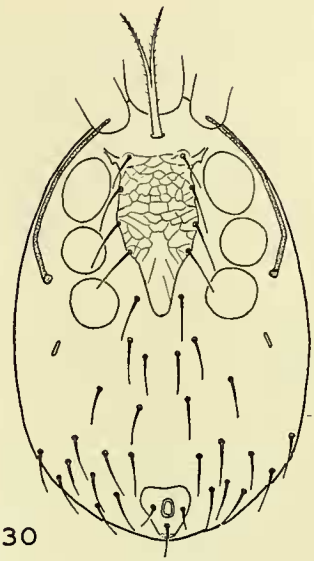
Deutonymph (Text-fig. 30,). The dorsal shield has distinct lateral incisions ; it is 600–690 μ long and 345–430 μ wide. The chaetotaxy is the same as in the female. The sternal shield is ornamented, it bears 4 pairs of long setae, which are longer than the ventral setae. The shield is broadest at the level of the third setae and tapers off behind the fourth pair. It does not project behind coxae IV. The peritreme reaches to the middle of coxa I. Other characters as in the female.

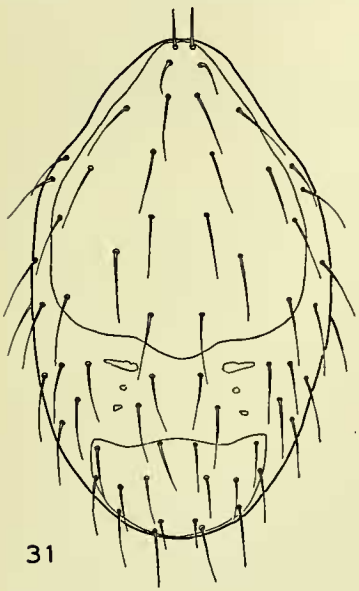
Protonymph (Text-figs. 31, 32). The anterior dorsal shield is 345 μ long and 300 μ wide, it bears 11 pairs of long setae. The setae on the pygidial shield are fairly long, except J5 which are only slightly over half the length of setae Z5. The sternal shield is ornamented on its anterior part, its anterior margin is hardly distinguishable from the ornamented presternal area. Three pairs of normal ventral setae and one pair of minute setae between coxae IV are inserted on the ventral membrane. The peritreme reaches to the middle of coxa III.

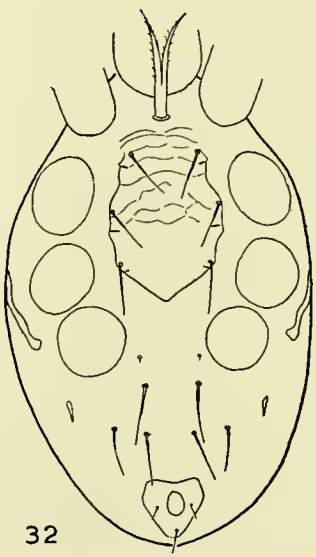
Hosts and localities. 14 pn, 3 dn, 11 ♀—*Meriones crassus*, Raman, 12.iv.1955 ; 2 pn, 2 dn, 1 ♂, 2 ♀—*Gerbillus dasyurus*, Rosh Zohar, 21.viii.1955 ; 1 pn, 2 dn, 4 ♂—*Nesokia indica*, Sedom.

Notes. *Haemolaelaps aegyptius* Keegan, 1956, is considered to be a synonym of *Haemolaelaps longipes* Bregetova, 1952. The paratype female of *H. aegyptius* in the collection of the British Museum (N.H.) having been compared with material of *H. longipes*, also in the collection. The most important diagnostic feature is the additional pair of setae in the *px* series (*px*1). Keegan (1956) lists this species from a wide range of gerbillids as well as from *Jaculus jaculus* and from *Rattus rattus*.





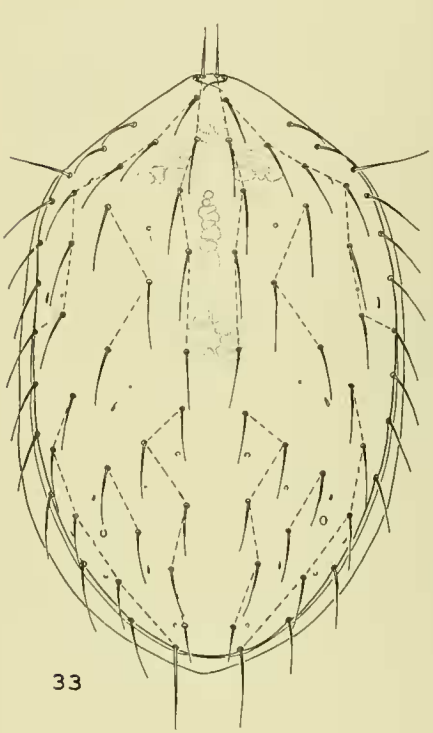


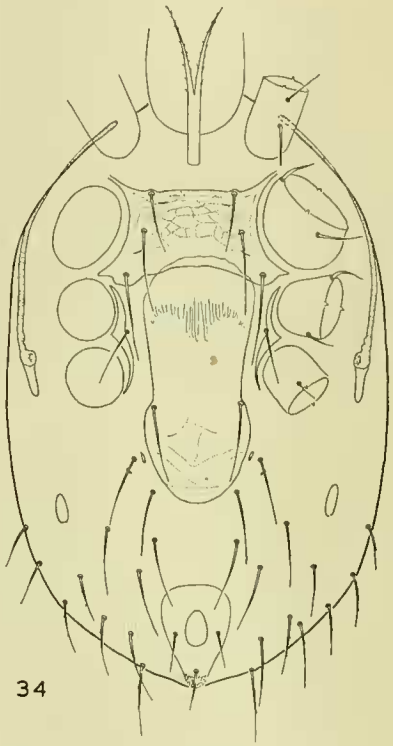


FIGS. 29–32. *Haemolaelaps longipes* Breg. Fig. 29, venter of male. Fig. 30, venter of deutonymph. Fig. 31, dorsum of protonymph. Fig. 32, venter of protonymph.

Haemolaelaps ovalis sp. nov.

Female (Text-figs. 33, 34). The dorsal shield is ovoid and covers most of the dorsal surface. It is 735–795 μ long and 450–495 μ wide. The mites are well sclerotized. The dorsal shield is ornamented on its anterior part, bears 39 pairs of setae and in some of the specimens (roughly 25%), one or two additional asymmetrical setae. Setae J5 are slightly less than half the length of setae Z5.





Figs. 33–34. *Haemolaelaps ovalis* sp. nov., female. Fig. 33, dorsal shield. Fig. 34, venter.

The strongly sclerotized tritosternum has a long shaft and feathered laciniae. The presternal area is faintly striated but the anterior margin of the sternal shield is well defined. The sternal shield is 90–102 μ long (at mid-line) and 160–172 μ wide (at the level of the second setae). The anterior margin of the sternal shield is fairly straight between the first pair of setae, the posterior margin is concave and slightly irregular. The pores are parallel to the anterior and to the posterior margin respec-

tively. The shield is ornamented mainly on its anterior half. The well-sclerotized postero-lateral corners of the shield project between coxae II and III. The bases of the first pair of setae are situated on the anterior margin of the shield and the setae do not reach the posterior margin of the shield. Their length is approximately two-thirds of the length of the second setae. The metasternal setae are about half the length of the third setae.

The genital shield is tongue-shaped, it expands posteriorly to the genital setae and it is faintly ornamented with striations. The anal shield is 118–128 μ long and 96–109 μ wide. The paranal setae are inserted at the level of the middle of the anus, they appear to be slightly longer than the postanal seta. The metapodal shields are narrow and elongated. The peritreme reaches to the middle of coxa I. Five pairs of smooth setae are inserted on the ventral integument, and 6–7 latero-ventral pairs are slightly barbed.

The legs are relatively short, their respective lengths (excluding pulvilli) are as follows : I—630 μ ; II—600 μ ; III—616 μ ; IV—870 μ.

Chelicerae chelate-dentate. The pilus dentilis on the fixed finger is only slightly inflated. There are 6 rows of deutosternal teeth, 3–4 teeth in each row.

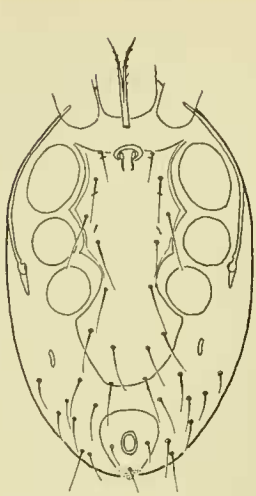
Male (Text-fig. 35). The dorsal shield is 585–615 μ long and 360–405 μ wide. The chaetotaxy is essentially the same as in the female. Only one out of ten specimens examined had additional asymmetrical setae. The anal shield is separate from the sternito-ventral shield. The sternito-ventral shield bears 8 pairs of setae and is throughout ornamented with striations. Chelicerae with long, slightly curved, spermatophoral process.

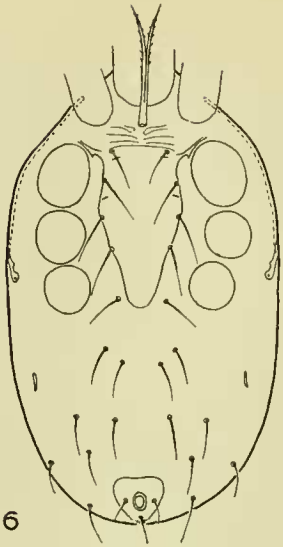
Deutonymph (Text-fig. 36). The dorsal shield is 480–570 μ long and 270–345 μ wide. The chaetotaxy of the dorsal shield is as in the female. The sternal shield bears four pairs of simple setae, it does not project behind coxae IV. The peritreme extends to the middle of coxa I. Eight to ten pairs of setae are inserted on the ventral membrane.

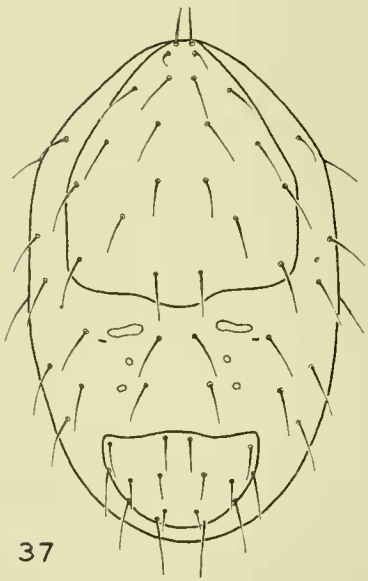
Protonymph (Text-figs. 37, 38). The anterior dorsal shield is 255–270 μ long and 225–240 μ wide. The median setae on the pygidial shield are markedly shorter than the marginal setae. The sternal shield is very pointed at its posterior margin. The distance between the setae of the second pair of the sternal setae is markedly greater than the distance between the setae of the first pair. Three pairs of ventral setae of normal length and one pair of minute setae between coxae IV are inserted on the ventral membrane. The peritreme is short and does not reach to the level of the hind margin of coxa III.

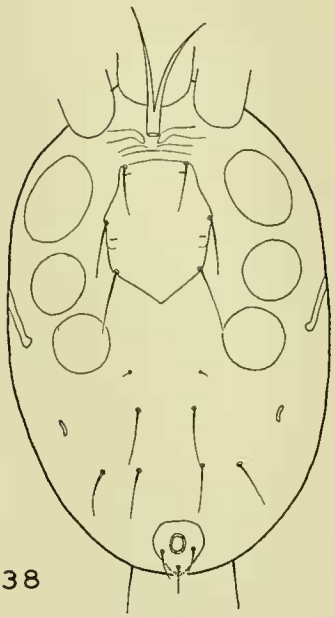
Hosts and localities. All specimens were recovered from *Meriones tristrami* at the following localities and dates : 18 pn, 13 dn, 3 ♂, 2 ♀—Mishmar Ha'emeq, 21.i.1952 ; 1 pn, 5 ♂, 12 ♀ (and numerous specimens in alcohol)—Nir David, 15.ii.1953 ; 7 pn, 2 dn, 2 ♂, 1 ♀—Shavei Zion, 22.viii.1955.

Notes. The new species which is similar to *Haemolaelaps longipes* Breg. differs from it in the following features : it has no additional pair of setae in the *px* series ; it is markedly smaller ; its first sternal setae are distinctly shorter than the sternal shield ; setae J5 are shorter.







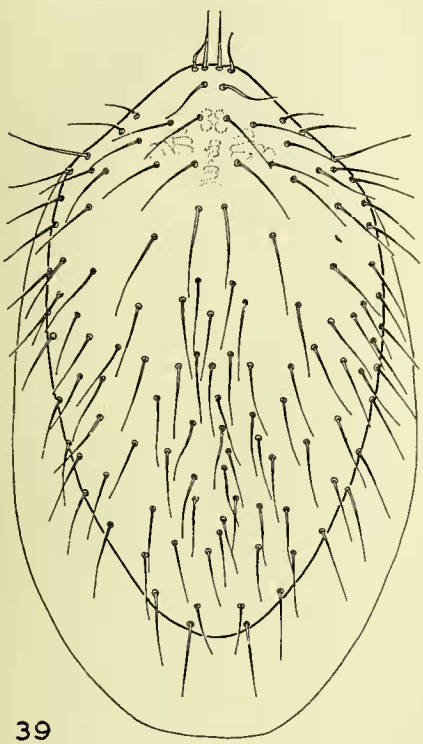


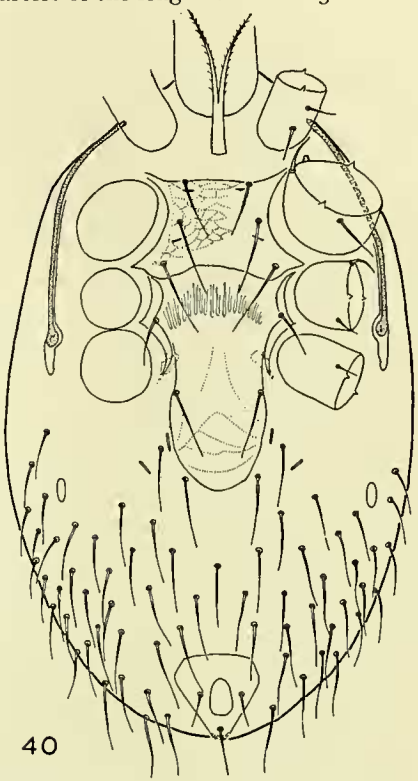
FIGS. 35–38. *Haemolaelaps ovalis* sp. nov. Fig. 35, venter of male. Fig. 36, venter of deutonymph. Fig. 37, dorsum of protonymph. Fig. 38, venter of protonymph.

Haemolaelaps centrocarpus Berlese, 1811

Haemolaelaps centrocarpus Berlese, 1911

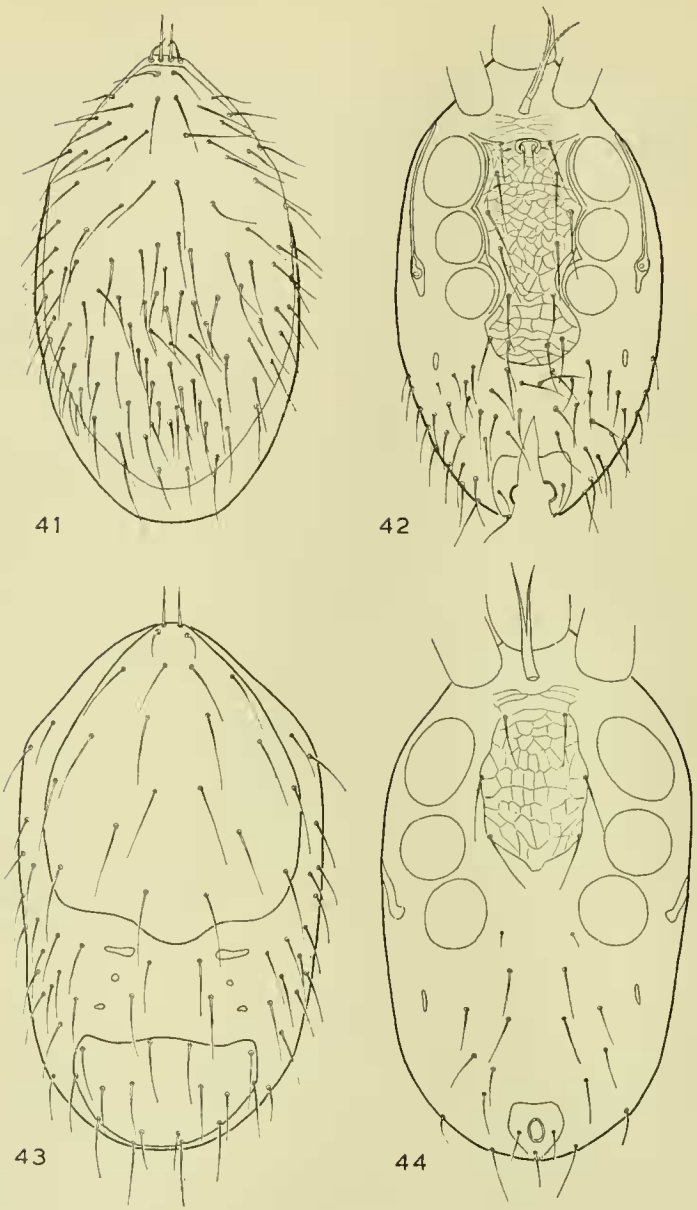
FEMALE (Text-figs. 39, 40). The dorsal shield is 1,020–1,080 μ long and 615–690 μ wide. In addition to the regular paired setae (including apparently setae *ax* and *px*1) the shield has 25–30 asymmetrical neosetae, mainly on its posterior part. The number of setae on the dorsal shield is therefore approxinately 110. All the setae are of normal length. Setae J5 are about three-quarters of the length of setae Z5.





FIGS. 39–40. *Haemolaelaps centrocarpus* Berlese female. Fig. 39, dorsal shield. Fig. 40, venter.

The tritosternum is well defined and has feathered laciniae. The presternal area is ornamented, but the anterior margin of the sternal shield is distinct. The sternal shield is 150–170 μ long (at mid-line) and 192–198 μ wide (at the level of the second sternal setae). The anterior margin of the shield is fairly straight, the posterior margin is concave. The anterior pores are parallel to the anterior margin of the shield, the posterior pores have a very slight outward slant. The shield is well ornamented throughout. The first sternal setae are markedly shorter than the second and third setae which are approximately of equal length. The metasternal setae are slightly over half the length of the third sternal setae.



FIGS. 41–44. *Haemolaelaps centrocarpus* Berlese. Fig. 41, dorsal shield of male. Fig. 42, venter of male. Fig. 43, dorsum of protonymph. Fig. 44, venter of protonymph.

The genital shield is only weakly sclerotized, it bears one pair of long genital setae which are slightly longer than the adjacent setae. The anal shield is triangular with a fairly straight anterior margin. It is approximately 160 μ long and 135 μ wide. The paranal setae are inserted in line with the middle of the anus and seem to be of equal length to the postanal seta. Approximately 35 pairs of setae are inserted on the ventral integument, most of the postero-lateral setae are slightly barbed. The peritreme reaches slightly beyond the posterior margin of coxa I. A peritrematal shield is present.

The two ventral setae of coxa I are of about the same length, the proximal seta is much stouter than the distal seta. On the proximal dorsal surface of femur I are two spur-like setae, a similar, somewhat smaller seta, is inserted on the trochanter. The respective lengths of the legs (excluding pulvilli) are as follows: I—975 μ; II—855 μ; III—990 μ; IV—1,290 μ.

The chelicerae are chelate-dentate, the pilus dentilis is only very slightly inflated and has a curved tip. The deutosternal teeth are arranged in 6 rows, 3–5 teeth in each row.

Male (Text-figs. 41, 42). The dorsal shield is 705–735 μ long and 405–480 μ wide, its chaetotaxy is essentially the same as in the female. The anal shield is separate from the sternito-ventral shield which bears 7–8 pairs of setae. The shape and the extent of the posterior margin of the shield are variable (as in *H. hirsti*, see Text-figs. 17, 18) and there is therefore a certain variation in the number of setae it bears and in its distance from the anal shield. The shield is distinctly ornamented throughout. The chelicerae bear elongated spermatophoral processes.

Deutonymph. The dorsal shield is 630–660 μ long and 390–410 μ wide. Its chaetotaxy is as in the female. The sternal shield is widest between the second and the third setae; it is ornamented throughout and its posterior margin does not project beyond the hind margins of coxae IV.

Protonymph (Text-figs. 43, 44). The anterior dorsal shield is 315 μ long and 270 μ wide. The number of setae on the dorso-lateral integument is higher than usual. Five to six pairs of setae are inserted on the ventral integument, a pair of minute setae is inserted between coxae IV. The sternal shield is faintly ornamented.

Hosts and localities. 1 ♀—*Gerbillus allenbyi*, Holon, 12.vii.1955; 2 ♀—*Gerbillus pyramidum*, ditto; 1 ♂, 1 ♀—*G. allenbyi*, Caesarea, 23.vii.1954; 7 ♀—ditto; 2 ♂, 15 ♀—ditto; 2 ♀—*G. pyramidum*, Palmahim, 2.ix.1954; 1 pn, 2 dn, 1 ♀—*Meriones sacramenti*, Holon, 9.xi.1954; 3 pn, 1 dn, 10 ♀—*Gerbillus gerbillus*, Yotvata, 14.iv.1955; 1 dn, 3 ♂, 3 ♀—*G. allenbyi*, Ma'agan Mikhael, 26.ix.1955; 1 ♂—ditto; 2 ♀—*M. sacramenti*, Nes Ziona, 22.v.1957; 2 dn, 10 ♀—*M. sacramenti*, Rishon le Zion (Dunes); 1 ♂, 46 ♀—*G. pyramidum*, ditto.

Notes. This species, although obviously related to *Haemolaelaps hirsti*, is most easily separated from the other species of *Haemolaelaps* by its large size and by its numerous long accessory setae.

LAELAPS C. L. Koch, 1839

Lange (1955) in his review on the genus *Laelaps* in the U.S.S.R. proposed a number of subgenera but Strandtmann & Wharton (1958) and Tipton (1960) did not adopt

Lange's subgeneric concepts. Tipton recognized four or five more or less distinct species groups separable on the basis of the distance between the epigynal setae.

Although the present study deals only with five species, it seems worth while to point out that they fall into three, clearly defined groups :

1. Species with 38 pairs of dorsal setae (only setae *px2* are inserted between the J and Z series), the male having a separate anal shield. This group includes only *Laelaps pachypus* C. L. Koch.

2. Species with 39 pairs of dorsal setae, femur I with very elongate and wavy dorsal setae ; the internal posterior rostral setae being rather short. This group includes *Laelaps ekstremi* Zachvatkin and *Laelaps agilis longispinosus* ssp. nov.

3. Species with 39 pairs of dorsal setae, femur I with only slightly elongated, straight and stout dorsal setae, the internal posterior rostral setae being very elongated. This group includes *Laelaps algericus* Hirst and *Laelaps acomydis* sp. nov.

In the present study the old nomenclature will be followed.

Although *Echinolaelaps echidninus* (Berlese) occurs in Israel (Gratz, 1957), it is not included in the present study as it has been recovered only from *Rattus norvegicus* in the Haifa port area.

Laelaps acomydis sp. nov.

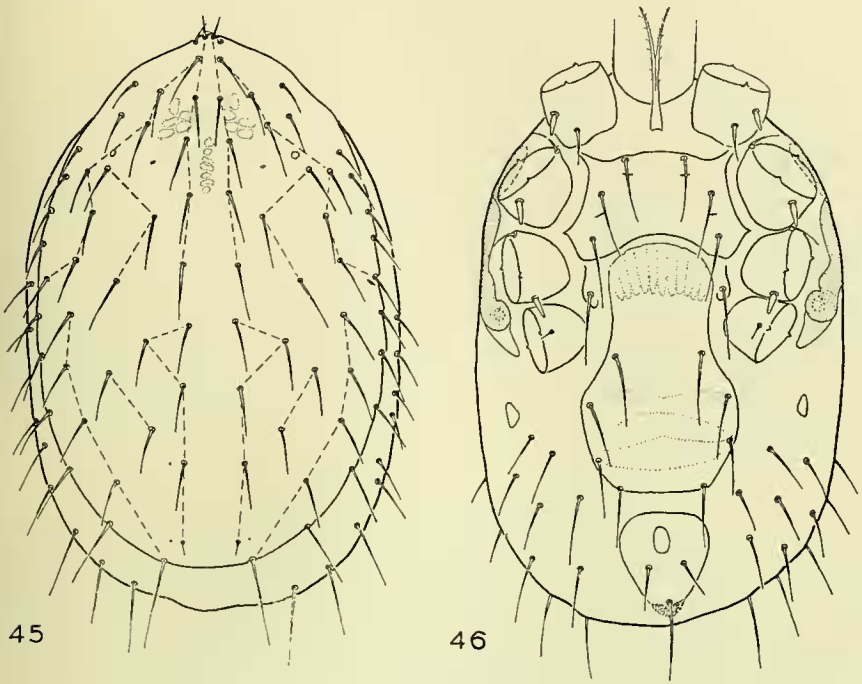
Female (Text-figs. 45, 46). The dorsal shield is ovoid and rather narrow, 525–540 μ long and 345–360 μ wide, it bears 39 pairs of setae. All the setae are simple and slender Setae J5 short (approximately 24 μ), setae Z5 long (approximately 86 μ). The anterior part of the shield is sculptured and has two pairs of distinct pores. Two setae, *px2* and *px3* are inserted between the J and Z series.

The tritosternum is well developed and has clearly defined, sparsely feathered laciniae. The presternal area is weakly ornamented, the anterior margin of the sternal shield is distinct. The sternal shield is 80 μ long (at mid-line) and 140 μ wide (at the level of the second setae). The anterior margin is only slightly convex, the posterior margin is markedly concave. The sternal shield has prominent postero-lateral corners which project at the level of the third sternal setae. The shield is ornamented with transverse striations. The anterior and the posterior pores are nearly horizontal. The first sternal setae do not reach the hind margin of the sternal shield. The metasternal setae are of the same length as the third sternal setae, they are inserted on small indistinct shields.

The genito-ventral shield is flask-shaped, broadest at the level of the second pair of setae. The distance between the setae of the first pair is approximately equal to the distance between the setae of the fourth pair. The shield is weakly ornamented with transverse striations.

The anal shield is roughly triangular, 108 μ long and 100 μ wide. The paranal setae are inserted usually at a point beyond the hind margin of the anus, their length is approximately 45 μ. The postanal seta is about 80 μ in length. The peritreme is very broad and conspicuous and extends anteriorly to the anterior margin of coxa II. A small peritrematal shield is present. The metapodal shields are in the form of elongated triangles with their bases directed externally. Eight to nine pairs of setae are located on the ventral membrane.

Legs I and II are stumpy while legs III and IV are more slender, their respective lengths (excluding pulvilli) being as follows : I—300 μ ; II—300 μ ; III—330 μ ; IV—360 μ. Femur I bears dorsally straight, stout and not very elongated setae. Coxa I with a proximal seta and a distal spur, coxae II and III with spurs, coxa IV with a small, hair-like, seta.



FIGS. 45–46. *Laelaps acomydis* sp. nov., female. Fig. 45, dorsum. Fig. 46, venter.

There are 6 rows if deutosternal teeth, 2–3 denticles in each row. The corniculi are horn-shaped, their proximal portions are broad and their distal parts are attenuated. The internal posterior rostral setae are longer than the corniculi (approximately 32 μ long), similar to the corresponding setae in *Laelaps algericus* (Text-fig. 65).

MALE (Text-fig. 71). Markedly smaller than the female and much narrower. The dorsal shield is 420–460 μ long and 240–255 μ wide. The dorsal shield bears more ornamentation than that of the female. The chaetotaxy of the dorsal shield is essentially the same as in the female. The holoventral shield bears 23 setae (anal setae included), and is ornamented with fine striations. Tarsus IV (118 μ in length) with simple setae only.)

HOSTS AND LOCALITIES. All the specimens, except 2 , were recovered from *Acomys cahirinus* at the following localities and dates : 2 ♀—Beit Alfa, 15.ii.1953 ; 6 ♀—

Beit Guvrin, 5.viii.1954 ; 1 pn, 1 dn, 13 ♀—ditto ; 2 ♂, 14 ♀—Nazareth, 17.viii. 1955 ; 5 ♀—Wadi Ara, 18.viii.1955 ; 5 ♂, 50 ♀—Kabri, 22.viii.1955 ; 11 ♂, 24 ♀—Mishmar Ha'emeq, 28.x.1955 ; 2 ♂, 22 ♀—ditto ; 2 ♂, 18 ♀—Carmel (Tivon), 22.ix.1956 ; 3 ♂, 5 ♀—Mishmar Ha'emeq, 26.ix.1956 ; 1 ♀—*Sekeetamys calurus*, Wadi Masri, 1.xi.1956 ; 1 ♀—*Meriones tristrami*, Shavei Zion, 22.viii.1955.

Notes. The new species seems to have a marked preference for *Acomys cahirinus* and it is actually the first *Laelaps* species recorded from the murine genus *Acomys*. In the key provided by Zumpt (1950) for the Ethiopian species of *Laelaps* the new species keys out as *Laelaps nuttalli* Hirst. It is obviously related to this species, but can be separated from it mainly by its broader and shorter peritreme which does not project beyond the anterior margin of coxa II (in *L. nuttalli* the peritreme projects anteriorly up to the middle of coxa I). Minor differences may also be found in the length of setae J5 which are longer in *L. nuttalli*. Moreover the sternal shield of *L. nuttalli* is longer and its hind margin is less concave. The males can be separated by the length of the peritreme and by the length of the setae on tarsus IV, which are approximately 38 μ long in *L. nuttalli* and about 29 μ long in *L. acomydis*.

In the key provided by Tipton (1960) the new species keys out as *L. lamborni* Hirst, however, it differs from the latter in the shape and the length of the sternal shield (approximately 120–130 μ in *L. lamborni*) and in the shape of the metapodal shields which are short and oval in *L. lamborni*. The setae on tarsus IV of the female are shorter in *L. acomydis* (approximately 32 μ) than in *L. lamborni* (approximately 50 μ).

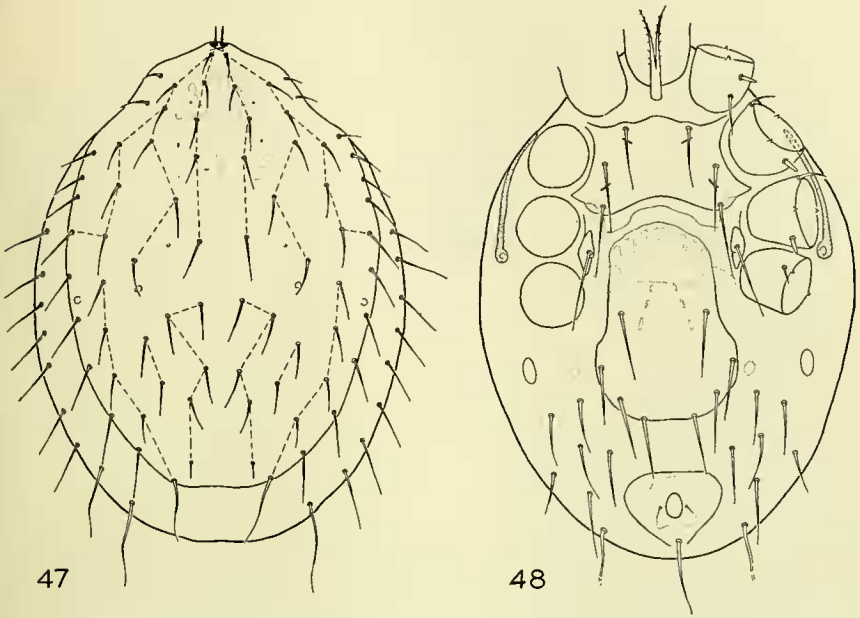
Laelaps agilis longispinosus ssp. nov.

Female (Text-figs. 47, 48). The dorsal shield is ovoid, it is 660–690 μ long and 470–500 μ wide. This mite is rather robust and well sclerotized. Thirty-nine pairs of setae are inserted on the dorsal shield. The posterior setae on the dorsal shield and those on the lateral membrane are rather wavy. Setae J5 are very short and do not reach the posterior margin of the dorsal shield. The anterior part of the shield is ornamented. There are many distinct pores on the shield. Two setae, *px*2 and *px*3, are inserted between the J and Z series.

The tritosternum has well-developed but sparsely feathered laciniae. The presternal area is only weakly sculptured. The anterior margin of the sternal shield is very convex, the posterior margin is strongly concave. The shield is 128–140 μ long (at mid-line) and 192–200 μ wide (at the level of the second setae). The anterior pores are slightly crescent-shaped with an inward slant, the posterior pores have an outward slant. First, second, third sternal and metasternal setae are gradually increasing in length in that order. The metasternal shields are well sclerotized, they are spindle-shaped.

The genito-ventral shield is broad, expanding half-way between the first and the second pair of setae and broadest at the level of the second pair. The posterior margin of the shield, between the setae of the fourth pair, is straight. The shield has no transverse striations. The second pair of setae is much nearer to the third pair than to the first pair. The metapodal shields are ovoid. The anal shield is distinctly ornamented around the anus. The shield is 100 μ long and 138 μ wide.

The paranal setae are inserted near the middle of the length of the anus and their length is approximately equal to the width of the anus. The postanal seta is very long, about five times the length of the paranal setae. The peritreme extends beyond the middle of coxa II.



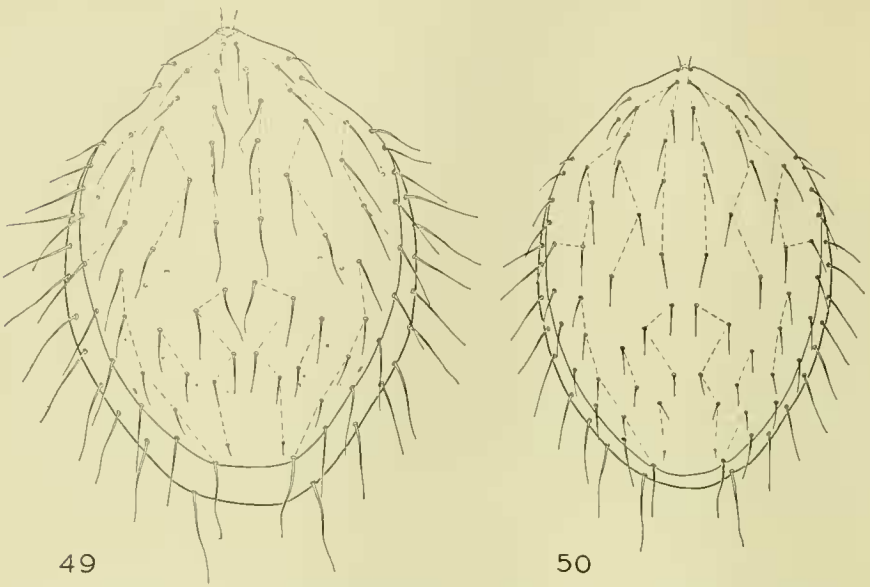
FIGS. 47–48. *Laelaps agilis longispinosus* ssp. nov., female. Fig. 47, dorsum. Fig. 48, venter.

The legs are robust, the fourth pair being the longest, approximately 615 μ (excluding pulvillus). The dorsal setae on femur I are very long and wavy. Coxa I with a piliform proximal seta, the distal seta being a blunt spur, coxae II and III with blunt spurs, coxa IV with a rather sharp spine. There are 6 rows of deutosternal teeth, 2–4 teeth in each row. The corniculi are broad at their bases and rather narrow in their distal halves. The internal posterior rostral setae (approximately 25 μ long) are shorter than the corniculi.

MALE (Text-figs. 49–53). The dorsal shield is 630–690 μ long and 445–490 μ wide. The chaetotaxy is essentially the same as in the female, but with much longer wavy setae on the anterior portion of the shield. The holoventral shield bears 21 setae (including the anal setae). The most distinctive feature of the male is leg IV which bears very long spines on the tarsus, the tibia and the genu.

DEUTONYMPH (Text-figs. 54, 55). The dorsal shield is 585 μ long and 405 μ wide. Setation as in the female. The anterior margin of the sternal shield is indistinct, the presternal area is weakly ornamented. The sternal shield bears 4 pairs of setae of approximately equal length. The posterior part of the shield, behind the fourth pair of setae, is in the shape of a broad tongue, almost touching the pair of setae

adjacent to it. The peritreme is short, reaching to the middle of coxa III. The anal shield is 108 μ long and 118 μ wide. Anal setae as in the female. About 10 pairs of ventral setae.

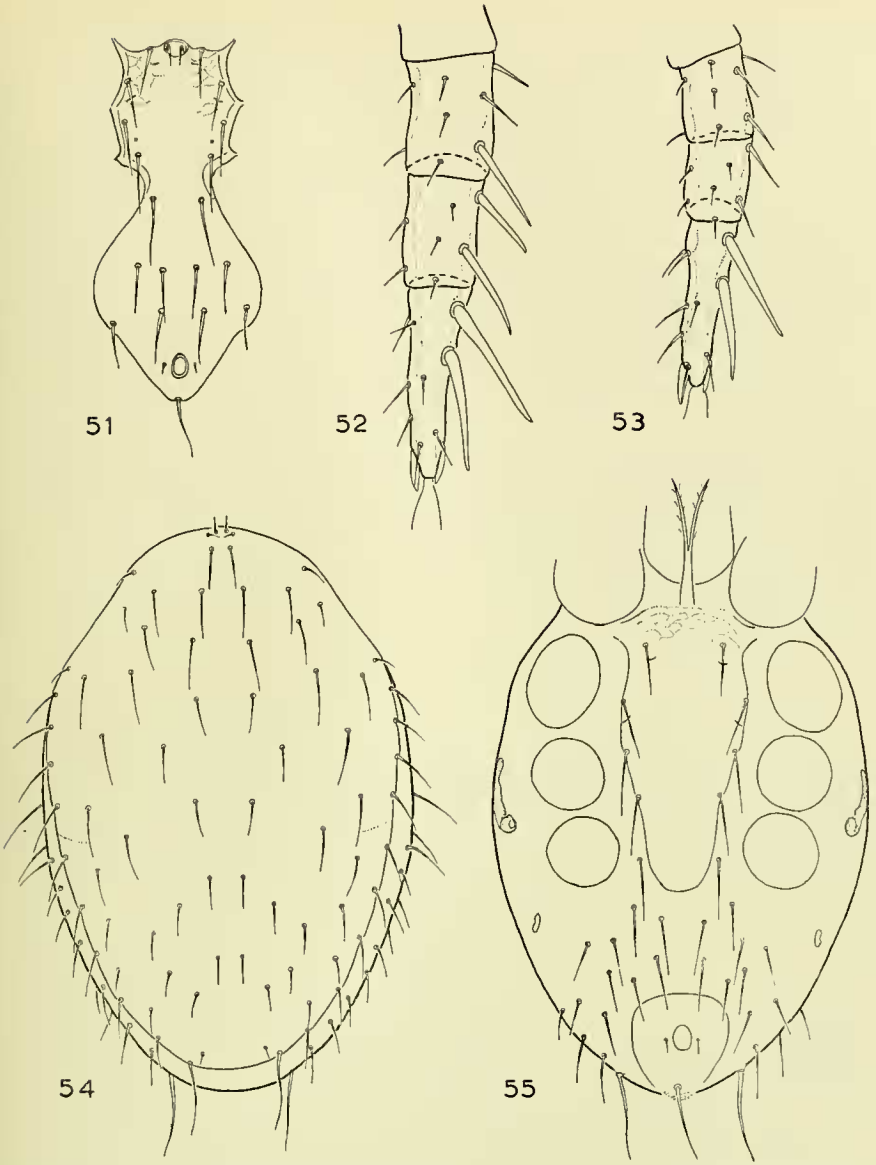


FIGS. 49–50. Fig. 49, *Laelaps agilis longispinosus* ssp. nov., dorsum of the male. Fig. 50, *Laelaps agilis* C. L. Koch (from *Apodemus sylvaticus*, Gt. Britain), dorsum of male.

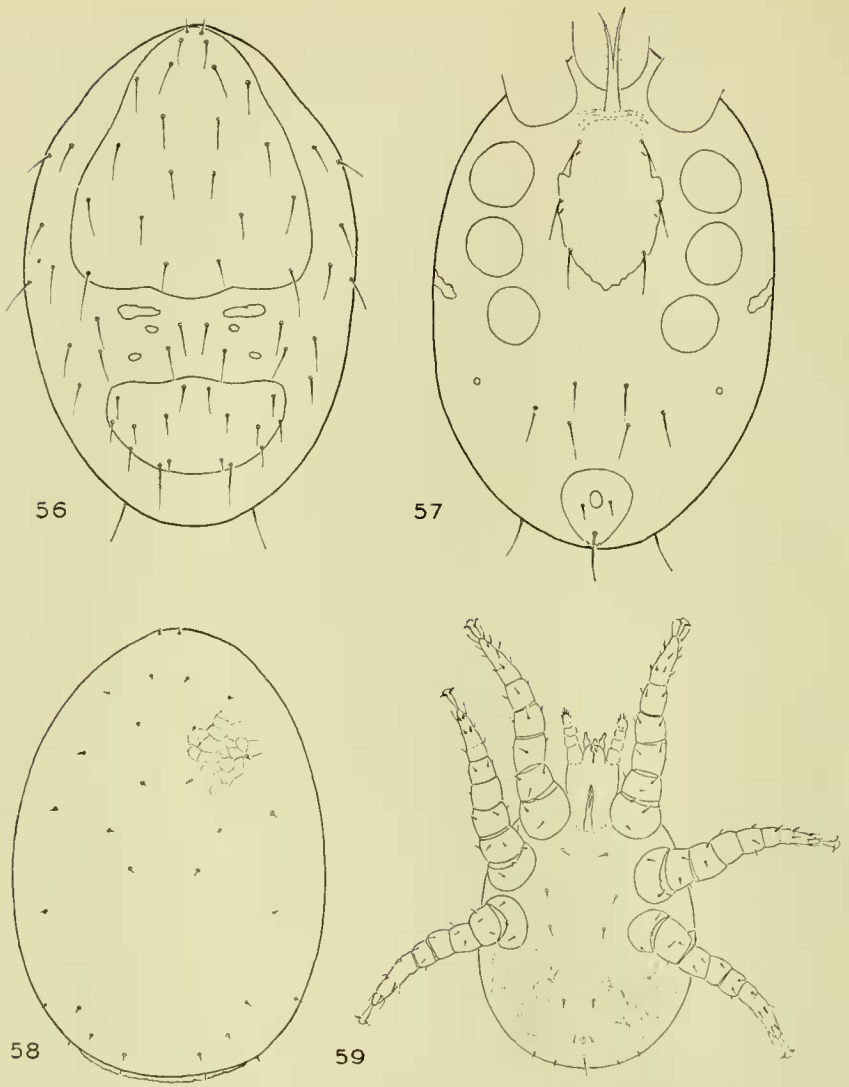
PROTONYMPH (Text-figs. 56, 57). The anterior dorsal shield is 345 μ long and 315 μ wide, it bears 11 pairs of setae. Most of the setae are of equal length, the outer posterior setae being the longest. All the setae on the pygidial shield, except the very short J5 and the very long Z5, are almost of the same length. The shape of the shield is as in Text-fig. 58, rather pointed at its posterior end. Anal shield and setae as in female.

LARVA (Text-figs. 58, 59). The body (excluding capitulum) is about 525 μ long and 405 μ wide. The larva, which in the genus *Laelaps* is non-feeding, has a very translucent cuticle through which the nymphal legs may be seen. The finely reticulated dorsum bears 14 pairs of small setae as well as 2 pairs of posterior setae, position and relative lengths of setae as in Text-fig. 59. The tritosternum stands out distinctly and is not feathered. There are 11 ventral setae (including anal setae), and the postanal seta is the longest seta on the ventral surface.

HOSTS AND LOCALITIES. All specimens were recovered from *Apodemus sylvaticus* at the following localities and dates: 1 pn, 2 ♂, 15 ♀—Sasa, 4.iv.1954; 1 dn, 3 ♂, 17 ♀—ditto; 22 ♀—ditto; 9 ♀—ditto; 1 larva, 1 pn, 1 dn, 4 ♂, 2 ♀—Yekhiam, 14.ii.1955; 9 ♂, 8 μ—Mishmar Ha'emeq, 28.ix.1956.



FIGS. 51–55. Fig. 51, *Laelaps agilis longispinosus* ssp. nov., venter of male. Fig. 52, *L. a. longispinosus* ssp. nov., leg IV of the male. Fig. 53, *Laelaps agilis* C. L. Koch, leg IV of the male. Fig. 54, *L. a. longispinus* ssp. nov., dorsum of deutonymph. Fig 55, *L. a. longispinosus* ssp. nov., venter of deutonymph.



FIGS. 56–59. *Laelaps agilis longispinosus* ssp. nov. Fig. 56, dorsum of protonymph. Fig. 57, venter of protonymph. Fig. 58, dorsum of larva. Fig. 59, venter of larva.

NOTES. The material from Israel on which this description is based was compared carefully with material of *Laelaps agilis* C. L. Koch in the collection of the British Museum (N.H.). Although no significant difference could be found between the females

of *L. agilis* and the Israel material, the males were seen to be markedly different. The males of the Israel material are more robust, have much longer setae and also differ in the setation of leg IV by having elongated and stout setae on the tibia and on the genu (Text-figs. 50, 51, 53, 54). It is therefore proposed to create the new subspecies *Laelaps agilis longispinosus* for the material from Israel. The host of these specimens *Apodemus sylvaticus* seems also to be the main host of *L. agilis* which has been recorded only from rodents of the genus *Apodemus* (Tipton, 1960).

The female of *Laelaps oraniensis* Hirst (only sex described) is also very closely related to *L. agilis* and could not be separated from the Israel females. The type material of *L. oraniensis* was collected off " field-mice " Mt. Marabut, Oran, which is well within the range of *A. sylvaticus* and it seems probable that this species was the host. Unfortunately the status of *L. oraniensis* cannot be assessed until males from the type locality and the type host are available for examination.

In a recent review of the genus *Laelaps* by Tipton (1960) the name *L. oraniensis* Hirst is assigned to a *Laelaps* species recovered from *Otomys* sp. (Gerbillinae), a rodent not occurring in the type locality. This species differs, according to Tipton's description from both *L. agilis* and the type material of *L. oraniensis* Hirst in the number of dorsal setae (stated to be 31 pairs only), as well as in the pattern of their relative position on the anterior part of the dorsal shield. The males have only short setae on tarsus IV (according to the drawing given by Tipton). It seems therefore that *L. oraniensis* Hirst sensu Tipton is a different species, apparently related to *L. nuttalli* Hirst.

Laelaps algericus Hirst

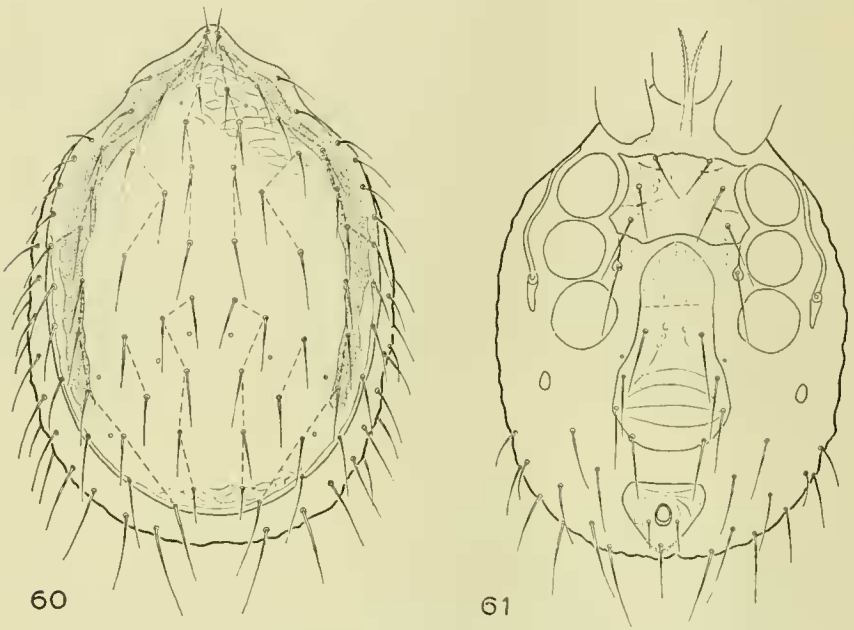
Laelaps algericus Hirst, 1925.

Female (Text-figs. 60, 61). The dorsal shield is 675–705 μ long and 480–510 μ wide (Hirst gives the length of the body without capitulum as 0·70 mm.). The most distinctive feature of this mite is the heavily sclerotized and pigmented band on the anterior and lateral margins of the dorsal shield. There is no sign of this sclerotization in the nymphal stages, the male is unknown. The dorsal shield is slightly ornamented, mainly on its anterior part. The shield bears 39 pairs of setae, all simple. Setae J5 are about half the length of setae Z5. Two setae, *px2* and *px3*, are inserted between the J and the Z series.

Tritosternum apparently with long shaft and with short, sparsely feathered laciniae. The presternal region is sclerotized and sculptured but the anterior margin of the sternal shield is well defined. The sternal shield is heavily sclerotized and slightly ornamented, mainly around the setae. The anterior margin of the shield is irregularly straight, and the central third of the hind margin is concave. The shield is 122–134 μ long (at mid-line) and 160–173 μ wide (at the level of the second setae). The anterior pores are nearly horizontal, the posterior pores are slightly at an angle. First, second, third sternal and metasternal seta gradually increasing in length in that order.

The genito-ventral shield is pear-shaped, broadest at the third pair of setae. The hind margin is almost straight and the shield is ornamented with striations. The faintly sculptured anal shield has a truncate anterior margin, and it is slightly wider

than long. The paranal setae are inserted in line with the posterior margin of the anus and their length is about half that of the postanal seta. The metapodal shields are irregularly oval, almost round. Ten pairs of setae are inserted on the ventral membrane. These are slightly longer than the dorsal setae. The peritreme extends anteriorly to the level of the posterior margin of coxa I and a narrow peritrematal shield is present.

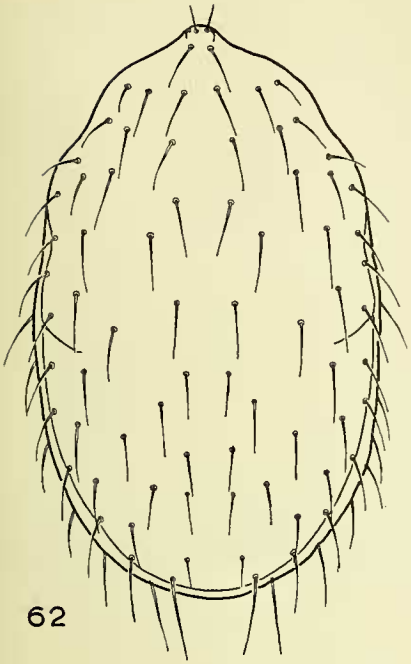


FIGS. 60–61. *Laelaps algericus* Hirst., female. Fig. 60, dorsum, Fig. 61, venter.

The legs are of the usual laelaptid type. The dorsal setae of femur I are much shorter than the setae on the dorsal shield. Coxae I, II and III bear blunt spurs. Tarsus IV with spiniform setae but without spurs. There are 6 rows of deutosternal teeth, 2–4 denticles in each row. The corniculi are distinct and horn-shaped. The chelicerae are chelate-dentate, the pilus dentilis is slightly inflated with a characteristic hook-like shape. The internal posterior rostral setae are very long (approximately 42 μ), much longer than the corniculi.

DEUTONYMPH (Text-figs. 62, 63). The dorsal shield is 570 μ long and 340 μ wide. Chaetotaxy the same as in the female. The sternal shield is elongated, its anterior

FIGS. 62–65. *Laelaps algericus* Hirst. Fig. 62, dorsum of deutonymph. Fig. 63, venter of deutonymph. Fig. 64, dorsum of protonymph. Fig. 65, ventral view of the gnathosoma of the protonymph.



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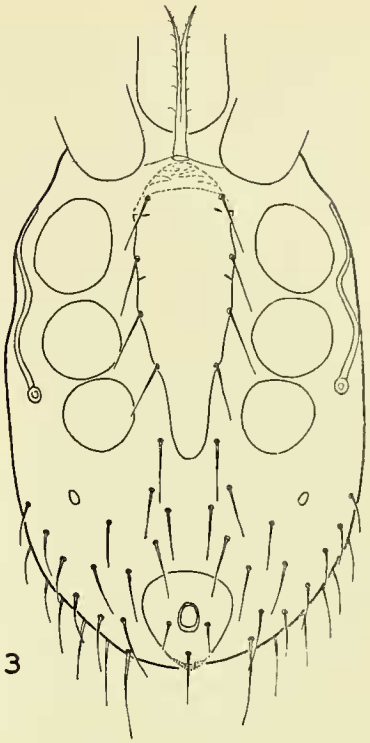

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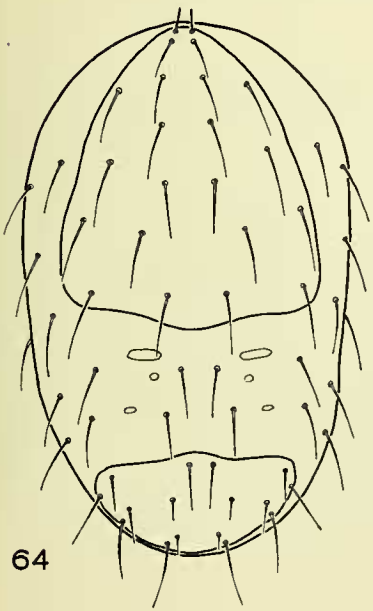

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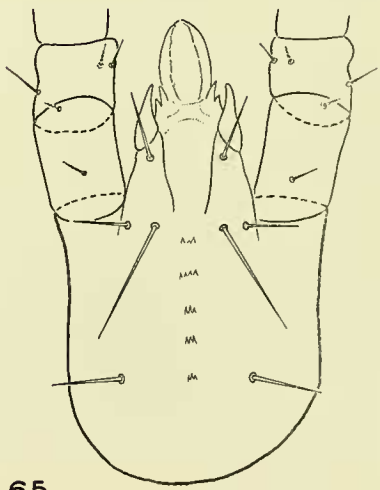


65

border is indistinct, the preseternal area is faintly ornamented. The sternal shield bears 4 pairs of setae which are of about equal length. Two small oval metapodal shields are present. The anal shield has a rounded anterior margin, anal setae as in the female. The peritreme reaches to the anterior margin of coxa II. The long internal posterior rostral setae are very conspicuous.

PROTONYMPH (Text-figs. 64, 65). The three pairs of platelets between the anterior shield and the pygidial shield are very well defined. Setae J4 and J5 on the pygidial shield are very short. The sternal plate has an indistinct anterior margin and it is broadest at the level of the second pair of setae. Three pairs of normal setae and one pair of minute setae between coxae IV, are inserted ventrally. An additional pair of elongated strong setae is inserted at the posterior end of the body. The long internal posterior rostral setae are conspicuous (Text-fig. 66).

HOSTS AND LOCALITIES. On *Mus musculus*, Mishmar Ha'emeq : 2 ♀—23.xii.1952 ; 2 ♀—26.xii.1952 ; 1 ♀—13.ii.1953 ; 4 ♀—21.ii.1953 ; 14 ♀—21.ii.1953 ; 3 ♀—22.ii.1953 ; 1 dn—22.ii.1953 ; 12 ♀—13.ii.1954 ; 12 ♀—13.ii.q954 ; 12 ♀—24.i.1955 ; 5 ♀—i.1955 ; 3 ♀.1.ii.1956 ; 8 ♀—13.ii.1958 ; Aqua Bella : 2 ♀—3.ii.1954 ; 5 ♀—16.vii.1957 ; Carmel : 2 pn, 22 ♀—22.ii.1956 ; Kishon : 5 ♀—16.vii.1957. Mishmar Ha'emeq, on *Microtus guentheri*, 1 ♀—21.iii.1953.

NOTES. The type material was taken from " *Mus algericus* " (apparently *Apodemus sylvaticus algirus* Pomel, 1856) and has been recorded from *Mus musculus* and *Crocidura olivieri* (Bregetova, 1956; Keegan, 1956). In Israel this species seems to be host-specific on *M. musculus* (the one female from *M. guentheri* may have originated from a *M. musculus* trapped at the same time.

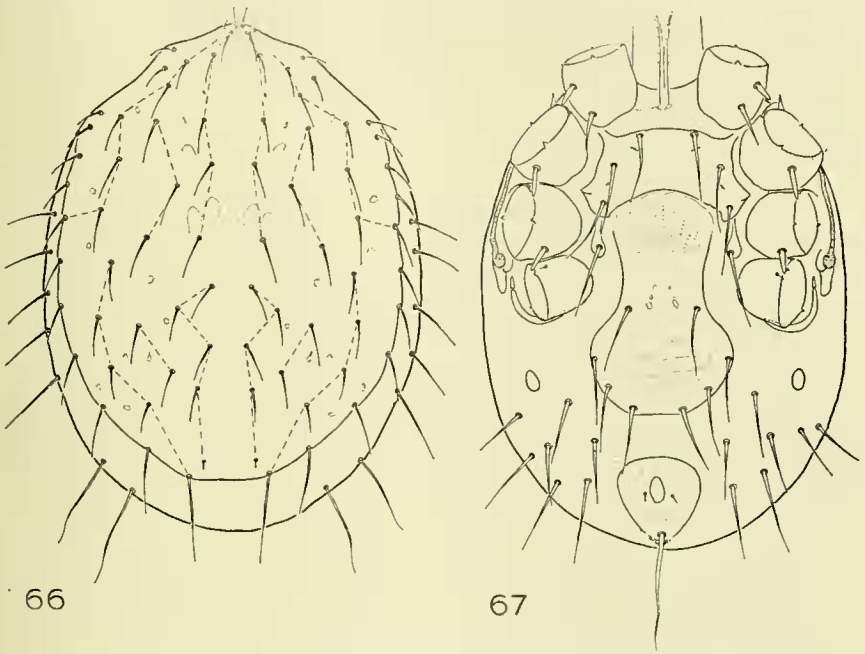
Laelaps ekstremi Zachvatkin

Laelaps ekstremi Zachvatkin, 1948.
Laelaps jettmari, Bregetova, 1956.

FEMALE (Text-figs. 66, 67). The dorsal shield is 570 μ long and 435 μ wide, it bears 39 pairs if simple setae. The most diagnostic feature of the dorsal setation is the lateral position of setae *r*1 in relation to setae *i*1 (in most other species of *Laelaps* setae *r*1 lie rather posteriorly to setae *i*1). Setae J5 are very short, approximately 9–10 μ while setae Z5 are very long, approximately 110 μ. The dorsal shield is slightly ornamented on its anterior part and it is provided with many distinct pores. The usual *px*2 and *px*3 setae occur between the J and Z series. All the dorsal setae are simple and their distribution and relative lengths are shown in Text-fig. 66.

The tritosternum has long, very slightly feathered, laciniae. The sternal shield is well sclerotized, it is 77 μ long (at mid line) and 116 μ wide (at the level of the second pair of setae). The anterior margin is very distinct and convex, while the posterior margin is markedly concave. The anterior pores are slightly crescent-shaped with an inward slant, the posterior pores have an outward slant. The first pair of sternal setae is longer than the sternal shield and project beyond the hind margin of the shield. The metasternal setae are not longer than the third pair of sternal setae. The metasternal shields are drop-shaped, almost reaching the posterior margin of the sternal shield.

The genito-ventral shield is flask-shaped, very narrow in front of the first pair of setae (approximately 102 μ at this level), broadest at the level of the second pair of setae (approximately 180 μ wide). The shield is ornamented with transverse striations. The posterior margin of the genito-ventral shield is truncated. The anal shield is 105 μ long and 106 μ wide. The paranal setae are very short (19 μ) while the postanal seta is long (128 μ) and wavy. There are about 7 pairs of ventral setae on



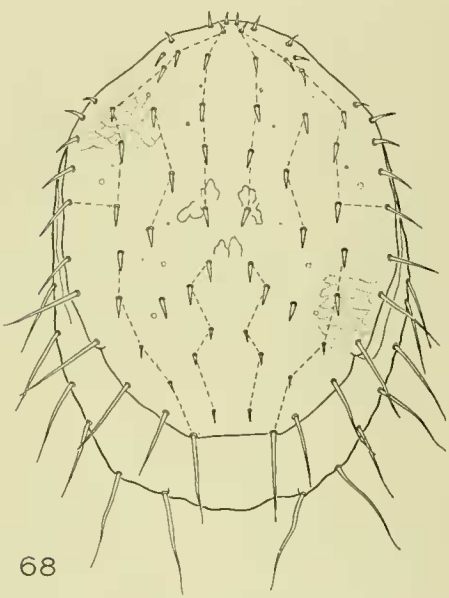
FIGS. 66–67. *Laelaps ekstremi* Zachvatkin, female. Fig. 66, dorsum. Fig. 67, venter.

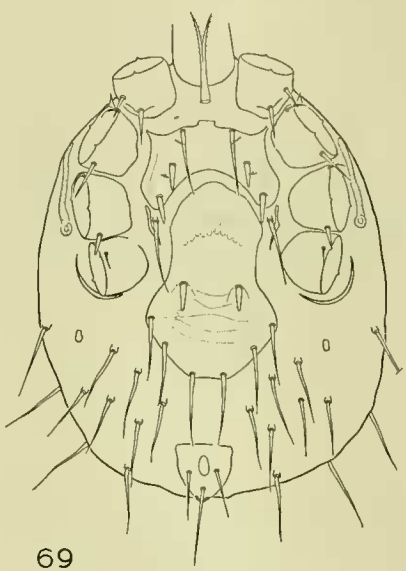
the membrane. The metapodal shields are oval and well sclerotized. The peritreme reaches to the middle of coxa I, a peritrenatal shield is present, not connected to the very distinct parapodal shield.

The legs are rather short, the first and second pair more robust, the third and fourth pairs more slender. Leg IV (excluding pulvillus) is 435 μ long. The dorsal setae of femur I are very long and wavy. On coxa I there is a proximal piliform seta and a distal blunt spur ; coxae II and III with blunt spurs (the spur of coxa II being longest) coxa IV bears ventrally only a small, almost hair-like, seta. There are 6 rows of deutosternal teeth, 2–3 denticles in each row. The corniculi are horn-shaped, the internal posterior rostral setae (approximately 16 μ long) are shorter than the corniculi.

MALE (Text-figs. 72, 73). The dorsal shield is 570 μ long and 425 μ wide. The chaetotaxy and the ornamentation of the dorsal shield are essentially the same

as in the female. The holoventral shield is well ornamented, especially on its posterior part. The shield, which bears 21 setae (including anal setae), is broadest immediately behind coxae IV and tapers off behind the last row of setae. The setae on the holoventral shield are shorter than the setae on the ventral and the lateral membranes. The metapodal shields are almost circular. The peritreme reaches to the middle of coxa II. A small peritrematal shield is present, it is rather distant from the parapodal shield which is much smaller than in the female. The legs are rather short, coxa III bears a blunt spur, coxae I and II bear sharp spines, coxa IV has a small seta. Tarsus IV (96 μ long, excluding pulvillus) bears 2 blunt short spurs distally and a similar spur on the row preceding them.





FIGS. 68–69. *Laelaps pachypus* C. L. Koch, female. Fig. 68, dorsum. Fig. 69, venter.

HOSTS AND LOCALITIES. 2 ♂, 7 ♀—*Cricetulus migratorius*, Dalia, 13.v.1955.

NOTES. Bregetova (1956) synonymized *L. ekstremi* Zachvatkin with *L. jettmari* Vitzthum. It has been found, however, that the female of *L. jettmari* differs in the following points from *L. ekstremi* :

(*a*) Setae *r*1 are posterior to setae *i*1 ;

(*b*) the sternal shield is much longer, it is 160 μ long ;

(*c*) the first sternal setae are short and do not reach the hind margin of the sternal shield ;

(*d*) the genito-ventral shield is broad and has no narrow neck.

I consider therefore that the validity of *Laelaps ekstremi* Zachvatkin, 1948, should be re-established.

Laelaps pachypus C. L. Koch

Laelaps pachypus C. L. Koch, 1839.
Tetragonyssus microti Ewing, 1933.
Laelaps kochi Oudemans, 1936.
Laelaps (*Hyperlaelaps*) *amphibius* Zachvatkin, 1948.
Laelaps (*Hyperlaelaps*) *arvalis* Zachv., 1948 *syn. nov.*

FEMALE (Text-figs. 68, 69). The dorsal shield is 540–570 μ long and 435–450 μ wide, 38 pairs of short, spiniform setae are inserted on it. Five pairs of setae (Z3, Z4 and J3–J5) on the posterior part of the shield are much smaller than the spines on the anterior part of the shield. The marginal setae of the dorsal shield are gradually increasing in size from short spiniform setae on the anterior margin to long and rather wavy setae on the posterior margin of the shield. Setae J5 are short (approximately 19 μ), setae Z5 are long (approximately 118 μ). Only one seta, *px*2, lies between the J and Z series. The dorsal shield is ornamented with scale-like ornamentations on the anterior part of the shield, and with transverse striations on its posterior part. Many punctuations are scattered over the surface of the shield.

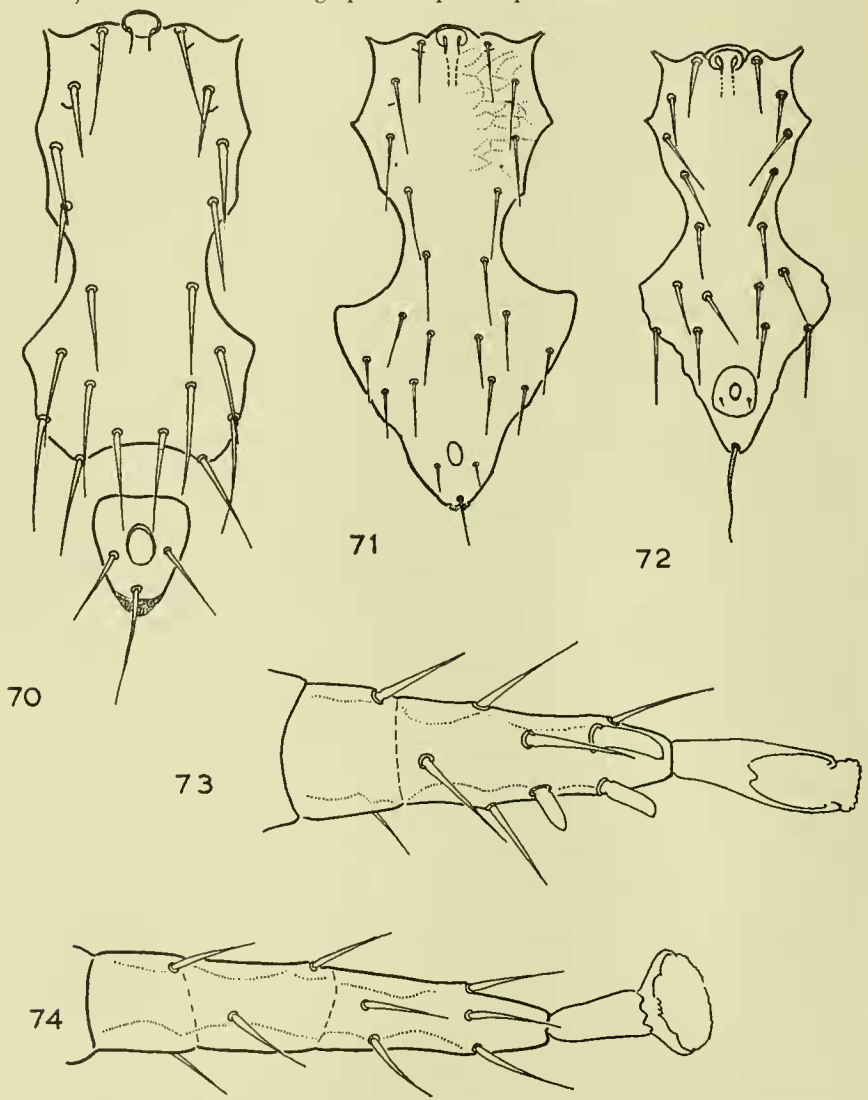
The tritosternum has long laciniae which are sparsely feathered with very short hairs. The sternal shield which is heavily sclerotized, is 77 μ long (at mid-line) and 195 μ wide (at the level of the second pair of setae). The anterior pores have a steep inward slant, the posterior pores have a slight inward slant. The anterior margin of the shield is convex, in many specimens with a slight projection in the middle (Text-fig. 69). The hind margin of the shield is deeply concave. The presternal area is only faintly ornamented. The first sternal setae are long and project beyond the hind margin of the sternal shield. The second and third sternal setae are short spurs with jagged tips so as to have the appearance of broken setae. The metasternal setae are apparently not inserted on metasternal shields, their length being approximately the same as that of the first sternal setae.

The genito-ventral shield is flask-shaped, broadest at the second pair of setae. The shield is ornamented with transverse striations. The third pair of setae is nearer to the second pair than to the fourth pair. The setae of the fourth pair are very near to each other. About 10 pairs of ventral setae are inserted on small projections of the integument. The metapodal shields are small, irregularly oval. The anal shield is 80 μ long and 90 μ wide. The paranal setae are long (77 μ), about two-thirds of the length of the postanal seta (118 μ). The peritreme reaches to the middle of coxa II, no peritrematal shield is discernible.

The first three legs are rather stumpy, the fourth pair is more slender and elongated. The respective lengths of the legs (excluding pulvilli) are as follows: I—360 μ; II—360 μ; III—375 μ; IV—555 μ. Coxa I bears two sharp spines, the proximal spine is much longer than the distal spine; coxa II bears a long spine, coxa III a short spine and coxa IV bears a hair-like seta. There are 6 rows of deutosternal teeth, 2 denticles in the first row and one denticle in each of the other rows. All rostral setae are short, the corniculi tapering off rather sharply.

MALE (Text-fig. 70). The dorsal shield is 525 μ long and 390 μ wide. The dorsal shield covers the dorsum more completely than in the female. The anal shield is separate from the sternito-ventral shield which bears 10 pairs of setae. The setae of the second and third pair are stouter than the other setae on the shield. The hind

margin of the shield is concave. The anal shield is 83 μ long and 77 μ wide, the anal setae as in the female. Tarsus IV bears simple setae only, it is 122 μ long (excluding pulvillus). Chelicerae with long spermatophoral processes.



FIGS. 70–74. Fig. 70, *Laelaps pachypus* C. L. Koch, venter of male. Fig. 71, *Laelaps acomysi* sp. nov., venter of male. Fig. 72, *Laelaps ekstremi* Zachv., venter of male. Fig. 73, *Laelaps ekstremi* Zachv., tarsus IV of male. Fig. 74, *Laelaps acomydis* sp. nov., tarsus IV of male.

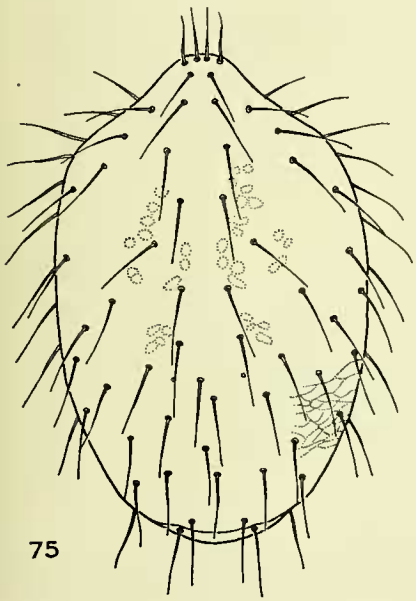
HOSTS AND LOCALITIES. This mite has been recovered in Israel only from *Microtus guentheri*, at the following localities and dates : 7 ♀—Mishmar Ha'emeq, 2.i.1953 ; 4 ♀—ditto ; 1 ♂, 1 ♀—ditto, 10.i.1953 ; 1 ♀—Neoth Mordekhai, 20.v.1955.

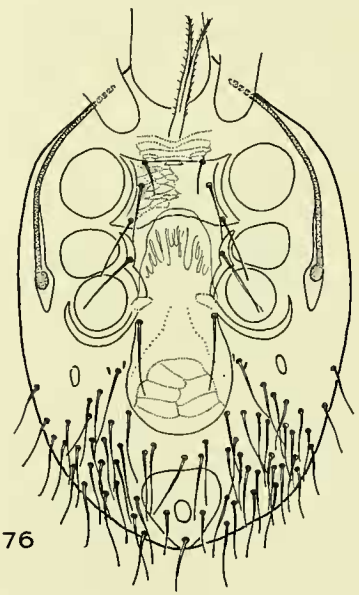
NOTES. The name *Laelaps pachypus* C. L. Koch has been adopted here for reasons summarized by Strandtmann & Wharton (1958). It seems to the writer that *L.* (*H.*) *arvalis* and *L.* (*H.*) *amphibius* are at the opposite ends of a series of intergrading forms of the same species. It may well be probable that the forms occurring on *Arvicola terrestris*, one of the larger microtines, are rather bigger than the forms occurring on the smaller microtines. Even if these differences were constant, both would merely be subspecies of *Laelaps pachypus* C. L. Koch. It is therefore considered that *L.* (*H.*) *arvalis* Zachv., 1948 should be placed in synonymy with *L. pachypus* C. L. Koch, 1839.

Androlaelaps marshalli Berlese

Androlaelaps marshalli Berlese, 1911.
Androlaelaps africanus Zumpt, 1950.
Androlaelaps africanoides Zumpt & Patterson, 1950.

FEMALE (Text-figs. 75, 76). The dorsal shield covers practically the whole of the dorsal surface, it is 1,095–1,155 μ long and 675–735 μ wide. The dorsal setae are very long (e.g. *i*5 is approximately 175 μ long). The arrangement of the posterior dorsal setae is irregular owing to the appearance of neosetae. Setae *r*1 are of about





FIGS. 75–76. *Androlaelaps marshalli*, Berlese, female. Fig. 75, dorsum. Fig. 76, venter.

the same length as setae *i*1 (approximately 125 μ), but whereas setae *i*1 are stout and straight, setae *r*1 are wavy. The dorsal shield is ornamented and striated throughout.

The tritosternum is well developed, with long feathered laciniae. The presternal area is ornamented and the anterior margin of the sternal shield is not very well defined. The sternal shield is 130 μ long (at mid-line) and 203–210 μ long (at the level of the second pair of setae), it is heavily ornamented. The anterior margin of the shield is slightly concave, the posterior margin is concave and emarginate. The first pair of sternal setae is considerably shorter than the other sternal setae, they do not reach the posterior margin of the sternal shield. The anterior pores have a slight inward slant, the posterior pores have a slight outward slant. The metasternal setae are inserted on well-developed endopodal shields.

The genital shield bears one pair of setae, it is moderately expanded behind coxa IV with a semicircular convex hind margin. The shield is flanked by a pair of setae, each of which is accompanied by two small elongated platelets. The posterior part of the shield is ornamented with very distinct striations. The metapodal shields are oval and elongated. The anal shield is almost triangular, it is 175–185 μ long and 175–188 μ wide, its anterior margin is slightly concave. The paranal setae are slightly shorter than the postanal seta, they are inserted in a line with the middle of the anus. The anus is more distant from the anterior margin of the anal shield than from the postanal seta. Numerous long and simple setae (approximately 25–28 pairs) are inserted on the ventral membrane. The peritreme reaches beyond the middle of coxa I, a peritrematal shield is present.

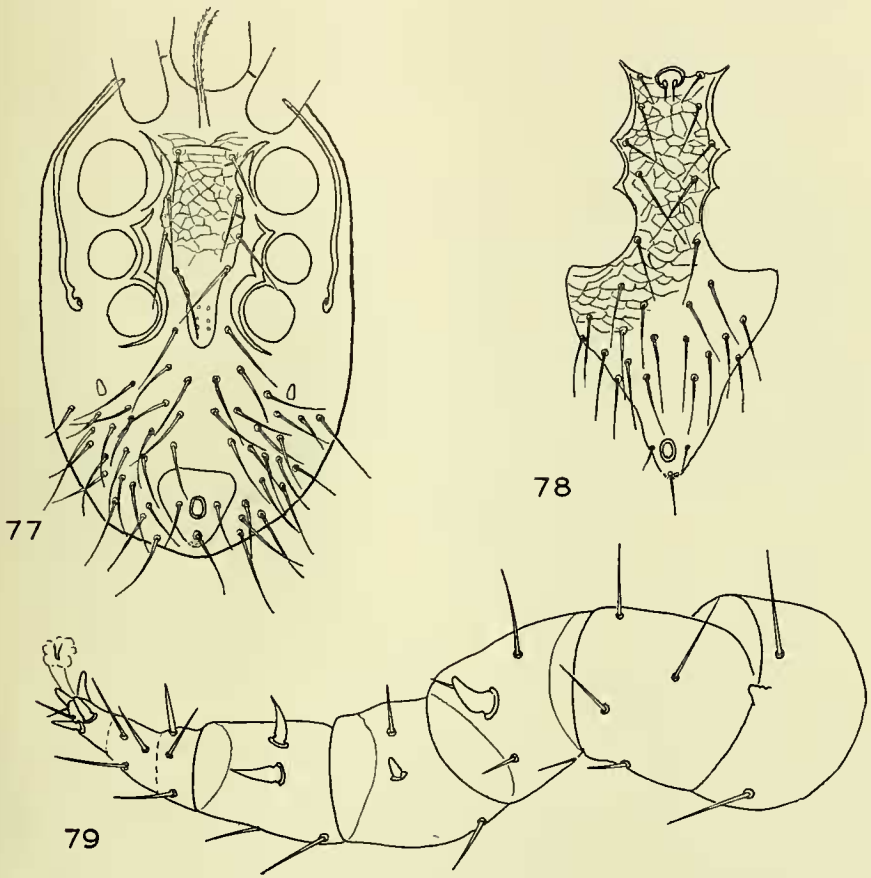
The second pair of legs is much stouter than the other pairs. Spurs are present on the ventral side of the femur, genu, tibia and tarsus. Coxa I with its anterior margin serrated. Leg IV is very slender and long, it is approximately 1,275 μ long (excluding pulvillus). The chelicerae are chelate-dentate, with a non-inflated pilus dentilis on the fixed finger. At the base of the movable digit a well-developed brush of many setae is present. The corniculi are well sclerotized, elongated and lanceolate. The internal posterior rostral setae are the longest of the gnathosomal setae (approximately 145 μ long), much longer than the corniculi. There are 6 rows of deutosternal teeth, 5 teeth in each row.

Male (Text-fig. 78). The dorsal shield is 945–990 μ long and 585–625 μ wide. The chaetotaxy is essentially the same as in the female. The holoventral shield is very expanded immediately behind coxae IV and it is markedly ornamented throughout. The shield bears 31 setae (including anal setae), the setae of the first pair are rather short. The paranal setae are inserted in line with the middle of the anus they are slightly longer than the postanal seta. Legs and spurs on legs essentially as in the female, length of leg IV—1,095 μ. The chelicerae have well-developed spermatophoral processes. There are 6 rows of deutosternal teeth, 2–5 teeth in each row.

Deutonymph (Text-figs. 77, 79). The dorsal shield is 840–945 μ long and 570–615 μ wide. The lateral incisions of the dorsal shield are very prominent. The dorsal chaetotaxy is the same as in the female. The sternal shield bears 4 pairs of setae, the first pair is markedly shorter than the other pairs. The shield is heavily ornamented, it is broadest at the level of the second setae and narrows after the fourth pair. The narrow part of the shield is without ornamented striations but it is marked by 3 pairs

of distinctly lighter spots. The shield does not project beyond coxa IV. The anal shield and leg II are similar to those of the female.

HOSTS AND LOCALITIES. 3 dn, 2 ♂, 11 ♀—*Gerbillus allenbyi*, Caesarea, 23.vii.1954 ; 1 dn, 6 ♀—ditto ; 1 ♂, 5 ♀—ditto ; 8 ♀—ditto ; 1 ♀—*Jaculus jaculus*, Palmahim, 2.ix.1954 ; 1 dn, 1 ♀—*Gerbillus pyramidum*, Palmahim, 4.ii.1955 ; 14 ♀—ditto ; 3 ♂, 1 ♀—*G. allenbyi*, Ma'agan Mikhael, 26.ix.1955 ; 1 dn, 9 ♀—*Meriones sacramenti*, Rishon le Zion (Dunes).

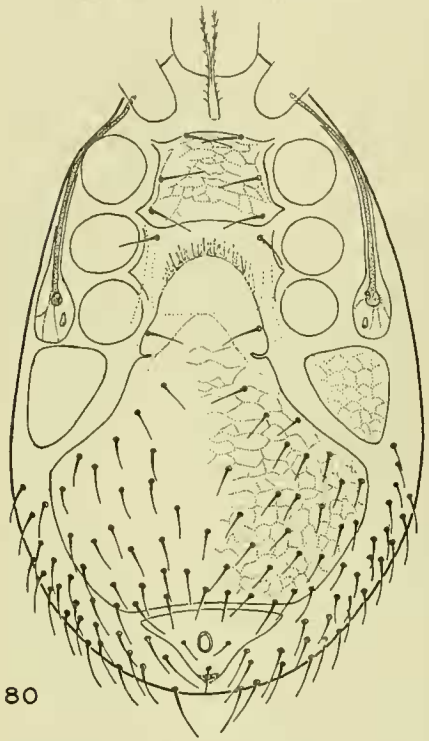


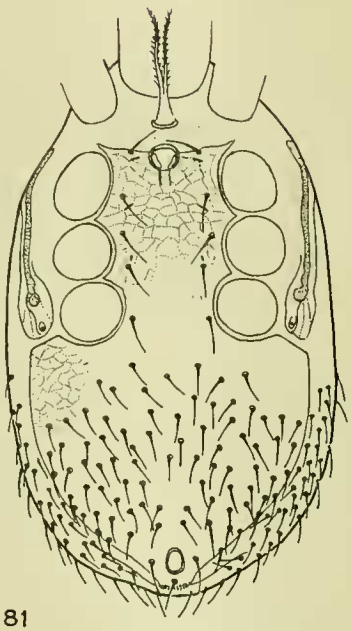
FIGS. 77–79. *Androlaelaps marshalli* Berlese. Fig. 77, venter of deutonymph. Fig. 78, venter of male. Fig. 79, ventral view of leg II of the deutonymph.

NOTES. This species was determined after comparing it with camera lucida drawings of the type specimen, kindly provided by Dr. G. O. Evans. Regarding the synonymy of this species I have arrived at the same conclusions as Keegan (1956).

Eulaelaps stabularis (Koch)

Gamasus stabularis C. L. Koch, 1836.
Hypoaspis stabularis, G. &. R. Canestrini, 1882.
Laelaps oribatoides Michael, 1892.
Laelaps stabularis Berlese, 1903.
Eulaelaps stabularis, Hirst, 1914.
Eulaelaps arcualis Trägårdh, 1912.
Eulaelaps oudemansi Turk, 1944.





FIGS. 80–81. *Eulaelaps stabularis* (Koch). Fig. 80, venter of female. Fig. 81, venter of male.

FEMALE (Text-fig. 80). Robust, heavily sclerotized and very setous mites. The dorsal shield is oval, broadest posterior to coxa IV. The shield is 1,005–1,050 μ long and 660–690 μ wide, it is covered with numerous setae, most densely on its lateral and posterior parts.

The tritosternum is well discernible and has pilose laciniae. The sternal shield is 145 μ long (at mid-line) and 175–185 μ wide (at the level of the second setae), it is well sclerotized and ornamented. The sternal setae are short, the first pair barely reaching beyond the middle of the sternal shield.

The genito-ventral shield is very expanded, sclerotized and ornamented, it bears 50–60 setae. The metapodal shields are very large, triangular in shape, well sclerotized

and ornamented. The anal shield is much wider than long, approximately 110 μ long and 230 μ wide. The peritreme reaches slightly beyond the posterior margin of coxa I, a well-developed peritrematal shield is present.

The chelicerae are chelate-dentate, a small non-inflated pilus is present on the fixed finger. A row of very small setae is present on the base of the movable finger. The corniculi are horn-shaped. There are 10 rows of deutosternal teeth, 6–8 teeth in each row.

The legs are relatively short, legs of pair II being stouter than the others.

Male (Text-fig. 81). The dorsal shield is 750 μ long and 450 μ wide. The chaetotaxy of the dorsal shield is essentially the same as in the female. The holoventral shield covers practically the whole venter, it is well sclerotized and ornamented. The shield bears approximately 90–100 setae. The peritreme reaches only to the level of the anterior margin of coxa II.

Hosts and localities. 2 ♀—*Meriones tristrami*, Beit Hakerem, 30.xii.1952; 1 ♀—*M. tristrami*, Mishmar Ha'emeq, 13.ii.1953; 8 ♀—*M. tristrami*, Tel Amal, 15.ii.1953; 4 ♀—ditto; 2 ♂, 364 ♀—ditto; 3 ♀—*M. tristrami*, Mishmar Ha'emeq, 22.ii.1953; 1 ♀—*Mus musculus*, ditto; 1 ♀—*Apodemus mystacinus*, Tivon, 9.iii.1953; 1 ♀—*M. musculus*, Aqua Bella, 3.ii.1954; 4 ♀—*Apodemus sylvaticus*, Dan, 1.iv.1954; 1 ♀—*Microtus guentheri*, Neoth Mordekhai, 20.v.1955.

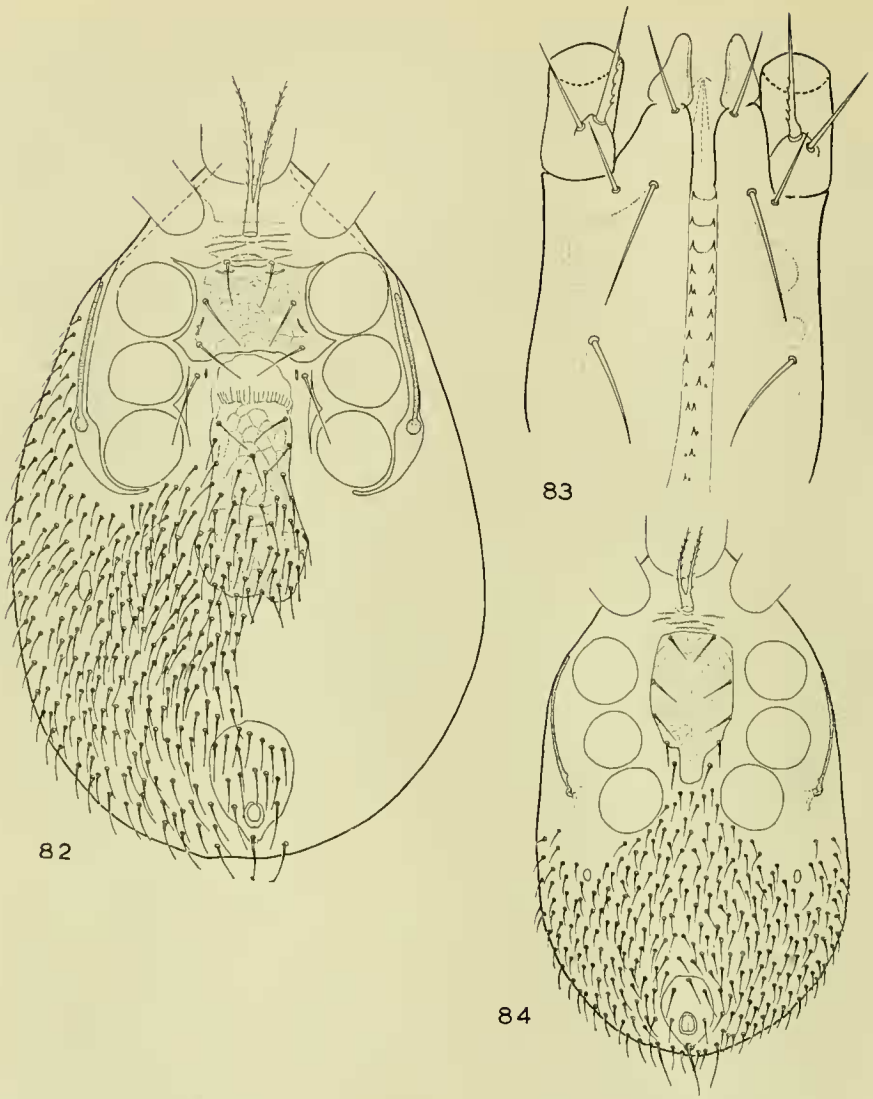
Notes. This species is a well known and widespread cosmopolitan species with many hosts (Strandtmann & Wharton, 1958). It apparently does not occur in the southern parts of Israel. It is worth while to mention the extremely high infestation of one specimen of *M. tristrami* with 2 ♂ and 364 ♀, which is an unsurpassed record in this collection. The same rodent was also infested with numerous specimens of *Haemolaelaps ovalis* sp. nov.

Haemogamasus horridus Michael

Haemogamasus horridus Michael, 1892.
Euhaemogamasus horridus, Keegan, 1951.
Haemogamasus horridus var. *arvicolarum* Berlese, 1920.
Haemogamsus arvicularum Turk, 1945.

Female (Text-figs. 82, 83). The dorsal shield is 1,260–1,290 μ long and 810–870 μ wide, it is densely covered with setae. Setae *i*1 are stouter than the other setae on the shield, they are approximately 85 μ long. The dorsal setae range from 40–90 μ in length. The shorter setae are inserted on the anterior part of the shield and they lengthen gradually towards the posterior part. There are no distinctly larger pairs of setae on the posterior margin of the shield. The distance between the dorsal setae is 16–40 μ and all the setae on the shield are smooth.

The tritosternum has long feathered laciniae, and on each side of its base a small tooth projects, at a distance of about two-thirds from its proximal end. The presternal area is sculptured, the striations having tiny, posteriorly directed spines. The sternal shield is 163–176 μ long (at mid-line) and 208 μ wide (at the level of the second pair of setae). The anterior margin is nearly straight, while the posterior margin is concave and slightly emarginate. The anterior pores are crescent-shaped, elongated and almost parallel to the anterior margin of the shield. The posterior pores lie



FIGS. 82–84. *Haemogamasus horridus* Michael. Fig. 82, venter of female. Fig. 83, ventral view of the gnathosome of the female. Fig. 84, venter of deutonymph.

almost at right angles to the anterior pores, being parallel to the lateral margins of the shield. The shield is ornamented with striations, it bears three pairs of smooth setae. The setae of the first pair are rather short and barely project beyond the middle of the shield. No accessory setae are carried on the sternal shield. The meta-

sternal setae are slightly shorter than the third sternal setae and each metasternal seta is flanked on its medial side by a small carrying a pore. Well developed endopodal shields lie on the uter sides of the metasternal setae.

The flask-shaped genito-ventral shield has an irregular posterior margin, and is ornamented throughout with striations. It bears 52 (in a second ♀, 53) setae. The pair of anterior setae are not longer than the other setae on the shield. The anal shield which bears 16 setae is pear-shaped, it is approximately 225 μ long and 160 μ wide. The anus is located at some distance from the anterior margin of the shield. Numerous setae are inserted on the interscutal membranes. The tubular part of the peritreme reaches to the middle of coxa II, it is surrounded by a peritrematal shield which reaches anteriorly to the gnathosoma, while posteriorly it is attached to the parapodal shields. The distal rims of the leg segments are serrated, the respective lengths of the legs (excluding pulvilli) being as follows: I—1,170 μ; II—900 μ; III—1,020 μ; IV—1,380 μ.

The chelicerae are chelate-dentate. The fixed digit has a hooked tooth on its distal end and slightly posterior to this are two additional, even more projecting teeth. The movable finger, which has a rather broad base, has three teeth at its inner distal end. On the ventral side of the palpal coxa there are two setae, the inner one being barbed on its medial side (Text-fig. 83). These are the only barbed setae on this species The gnathosomal setae are smooth and the corniculi are rounded and membraneous. There are 13 rows of deutosternal teeth, the anterior rows having 2 rather large teeth in each row. The relative lengths and the arrangement of deutosternal teeth is shown in Text-fig. 84. The tectum forms an obtuse angle at its anterior margin and is bordered by membraneous fimbriae.

Deutonymph (Text-fig. 84). The dorsal shield is 795 μ long and 510 μ wide. The chaetotaxy of the dorsal shield, the tritosternum and the presternal area are the same as in the female. The sternal shield bears 4 pairs of setae and narrows abruptly behind the fourth pair of setae into a finger-like projection. The shield is ornamented and terminates anteriorly to the mid-line of coxa IV. The peritreme apparently reaches to the middle of coxa II and is not accompanied by any shield. The anal shield bears 6 setae.

Hosts and localities. The only material of this species in the collection (4 dn, 2 ♀) was taken off *Apodemus mystacinus* (not from nest), at Tivon, 24.ii.1956.

Notes. The status of *Haemogamasus arvicularum* Turk is discussed in detail by Keegan (1951), and this author considered that it should be placed in synonymy with *H. horridus* Michael. The Tivon material has been compared with the type specimen of *H. horridus* Michael and was found to differ mainly in relation to the shape of the sternal shield, which in the Tivon material is wider than long. However the specimens from Tivon agree rather closely with Turk's description of *H. arvicularum*. Among the differences between *H. horridus* and *H. arvicularum* is the presence of a larger number of setae on the genito-ventral shield of the latter and it is interesting to note that in the Tivon specimens, which are apparently on the southern limit of the distribution of this species, the number of setae on the genito-ventral shield and on the anal shield is even greater than that noted for *H. arvicularum*. It might be possible in the future to separate *H. horridus* from different areas into subspecies.

For the time being the conclusions reached by Keegan (1951) have been accepted here.

Hirstionyssus arcuatus (C. L. Koch)

Dermanyssus arcuatus C. L. Koch, 1839.
Liponyssus arcuatus, Oudemans, 1913.
Hirstionyssus arcuatus, Fonseca, 1948.
Dermanyssus albatus Koch, 1839.
Hirstionyssus talpae Zemska, 1954.

FEMALE (Text-figs. 85, 86). The dorsal shield is 540–570 μ long and 300–330 μ wide, it is broadest behind the fourth pair of legs. The shield bears 26 pairs of small setae. The marginal setae as well as the setae on the anterior part of the shield, are longer than those on the central part. The shield is faintly ornamented.

The tritosternum is membraneous and translucent and very hard to discern from underlying structures, its base is rather broad and trapezoid in outline. The presternal area is sculptured with transverse lines. The anterior margin of the sternal shield is slightly convex, while the posterior margin is deeply concave, the concavity ascending up to the line of insertion of the second pair of setae. The sternal shield is 29–35 μ long (at mid-line) and 109–135 μ wide (at the level of the second pair of setae). The sternal pores are very small and indistinct. The sternal setae are much longer than the dorsal setae while the metasternal setae are slightly shorter than the sternal setae.

The genital shield is tongue-shaped, it is broadest slightly behind the point of insertion of the genital setae. The anal shield is much longer than wide, it is 115 μ long and 70 μ wide. The paranal setae, which are only slightly shorter than the postanal seta, are inserted slightly anterior to the middle line of the anus. About 12 pairs of setae lie on the ventral membrane. The peritreme extends to the middle of coxa I.

The legs are rather slender, their respective lengths (excluding pulvilli) being: I—375 μ ; II—315 μ ; III—300 μ ; IV—390 μ. Coxa I bears two ventral setae, the proximal seta being longer and stouter ; coxa II bears the usual anterior-dorsal spine and one postero-ventral spine ; coxa III bears two postero-ventral spines while coxa IV bears a small postero-ventral spine. The chelicerae are narrow and edentate. The deutosternal teeth are arranged in irregular rows of single teeth, alternating on both sides of the median line.

MALE (Text-figs. 87, 88, 89). The dorsal shield is 485 μ long and 300 μ wide, with parallel sides but slightly ovoid in shape. The shield bears 28 pairs of setae. The marginal setae on the posterior part of the shield are inserted at some distance from the edge of the shield. The holoventral shield, which bears 19 setae (anal setae included), is granulated. The 18–20 pairs of setae which lie on the ventral membrane

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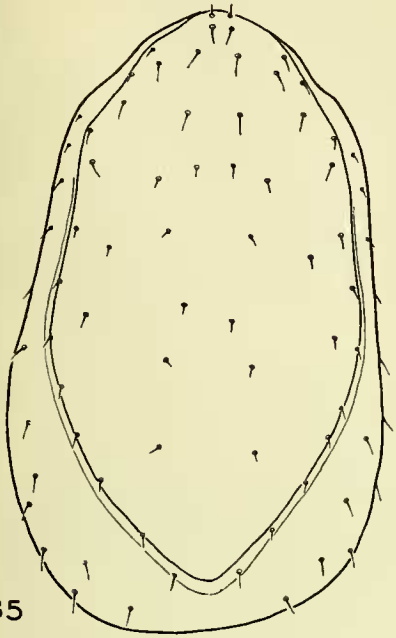
FIGS. 85–89. *Hirstionyssus arcuatus* (C. L. Koch.) Fig. 85, dorsum of female. Fig. 86, venter of female. Fig. 87, dorsum of male. Fig. 88, venter of male. Fig. 89, coxae II–IV of male.



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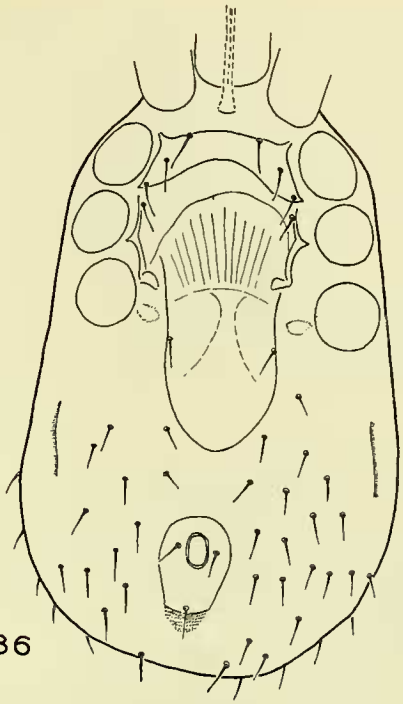

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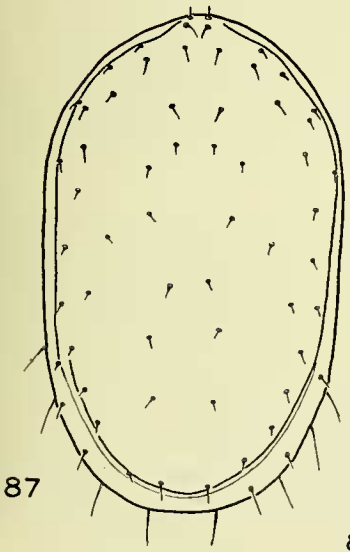

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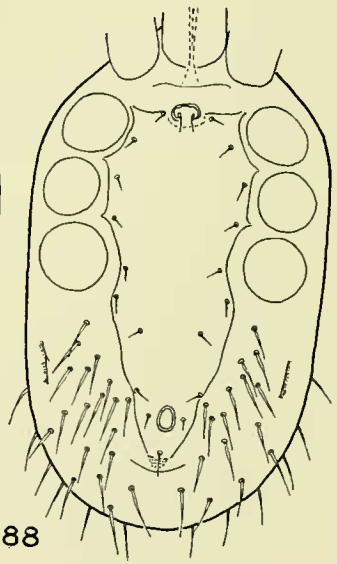

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are distinctly longer than the setae on the holoventral shield. The paranal setae are inserted anterior to the middle line of the anus. The peritreme reaches to the middle of coxa I. The lengths of the legs (excluding pulvilli) are as follows: I—330 μ; II—285 μ; III—300 μ; IV—360 μ. The chelicerae carry spermatophoral processes of medium length. The arrangement of the deutosternal teeth and the coxal spines, as in the female.

HOSTS AND LOCALITIES. Numerous specimens off *Rattus rattus*, Mishmar Ha'emeq, 22.xi.1952; 3 ♀—*Gerbillus* (*Dipodillus*) *dasyurus*, Wadi Nafkh, 11.iv.1955; 1 ♀—ditto; 1 ♂, 8 ♀—*Microtus guentheri*, Mishmar Ha'emeq, 13.v.1955; 1 ♀—*M. guentheri*, Neoth Mordekhai, 20.v.1955.

NOTES. The four females taken off *G. dasyurus* have a much smaller spine on coxa II than the specimens from the other hosts. However, as this was the only difference detected, these are considered to be *arcuatus*.

Hirstionyssus craticulatus Keegan

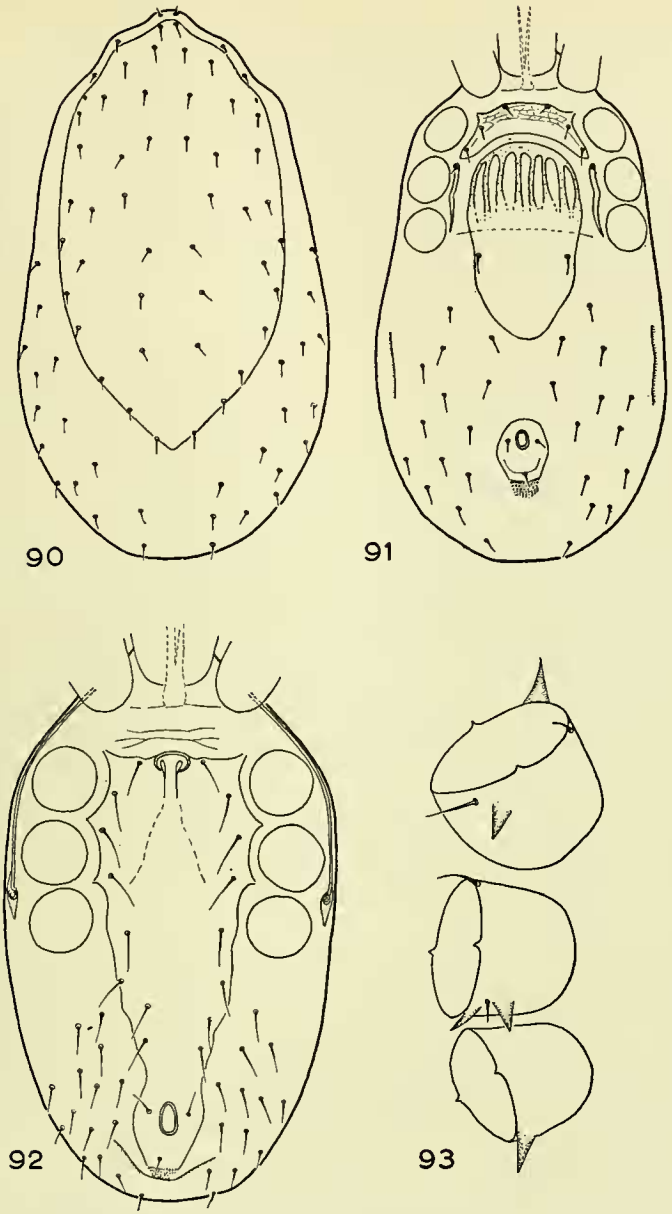
Hirstionyssus craticulatus Keegan, 1956.

FEMALE (Text-figs. 90, 91). The dorsal shield is ovoid, it is 420–465 μ long and 225–240 μ wide. The shoulders are well pronounced and the shield is attenuated posteriorly. The shield bears 25 pairs of setae. The setae which are inserted on the anterior part of the shield are slightly longer and stouter than those inserted on the posterior part. The surface of the shield is ornamented with fine striations which form irregular polygons.

The tritosternum is membraneous and translucent, and difficult to discern from underlying structures, it is apparently only very slightly pilose. The presternal area is slightly sculptured. The anterior margin of the sternal shield is well defined and strongly convex, while the posterior margin is markedly concave although the concavity does not reach the line connecting the second sternal setae. The anterior part of the shield is highly sculptured and more heavily sclerotized than the posterior part. The sternal shield is 32 μ long (at mid-line) and 102 μ wide (at the level of the second setae). The sternal and the metasternal setae are about the same length (approximately 30 μ). The endopodal shields are narrow but well developed and distinct.

The genital shield is the most diagnostic feature of this mite. The anterior part of the shield is shaped like a dome supported by 8 pillars, the posterior part being narrower and bearing the genital setae. About 14 pairs of setae lie on the ventral membrane. The anal shield is pear-shaped and has a rounded anterior margin, it is 86–92 μ long and 60 μ wide. The paranal setae, which are in line with the mid-point of the anus, are slightly shorter than the postanal seta. The peritreme reaches to the middle of coxa I.

The legs are rather slender, their respective lengths (excluding pulvilli) being as follows: I—300 μ; II—240 μ; III—240 μ; IV—315 μ. Coxa I bears a large spur antero-dorsally and a blunter spur postero-ventrally. Two postero-ventral spurs are located on coxa III, while coxa IV carries a small spur postero-ventrally on the coxal rim. The chelicerae are edentate and narrow, the distal end of the fixed digit being



FIGS. 90–93. *Hirstionyssus craticulatus* Keegan. Fig. 90, dorsum of female. Fig. 91, venter of female. Fig. 92, venter of male. Fig. 93, coxae II–IV of male.

hook-shaped. The deutosternal teeth (about 14), are arranged in irregular rows of single teeth on both sides of the median line.

Male (Text-figs. 92, 93). The dorsal shield is 360–375 μ long and 210–230 μ wide. The shield is ovoid with a rounded posterior margin and it bears 34 pairs of setae (the number of dorsal setae may be variable as some setae lie on the membrane immediately adjacent to the shield). The surface of the shield is ornamented as in the female. The presternal area is highly ornamented and the holoventral shield bears 19 setae (including anal setae). This shield is slightly constricted in front of the anus. About 14 pairs of setae are located on the ventral membrane. The arrangement of the coxal spurs is similar to that of the female. The male of this species has hitherto not been described.

Hosts and localities. All the specimens were taken from *Gerbillus pyramidum* at Holon, 12.vii.1954. The counts of mites found on four individuals were : 4 ♂, 12 ♀ ; 2 ♂, 6 ♀ ; 1 ♂, 7 ♀ ; 6 ♀.

Notes. Although Keegan (1956) recorded this species from *Gerbillus gerbillus* and *Jaculus jaculus* it was not found on these rodents in the area of the present study.

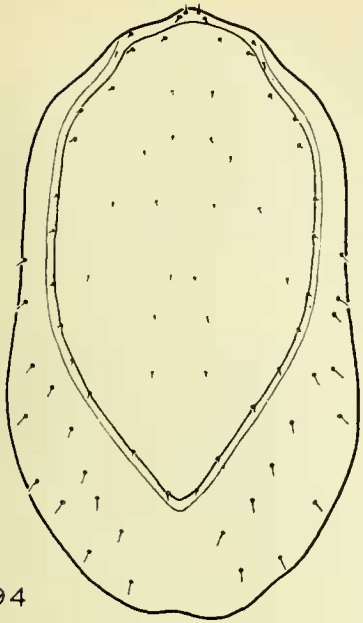
Hirstionyssus ellobii spalacis ssp. nov.

Female (Text-figs. 94, 95, 96). The dorsal shield is 600–630 μ long and 300–345 μ wide, it has well-pronounced shoulders and is attenuated posteriorly. The shield bears 26 pairs of setae of which only the anterior and marginal ones are prominent although very short, the other setae require high magnification for their definition.

The tritosternum has a broad base and long laciniae, the latter being feathered distally with very short hairs. The presternal area is not ornamented. The sternal shield is 86–94 μ long (at mid-line) and 160–170 μ wide. The shield has an almost straight anterior margin, the posterior margin being convex. The setae of the first pair do not reach the posterior margin of the shield. The sternal and metasternal setae are of approximately the same length. The anterior membraneous part of the genital shield overlaps the sternal shield. The anal shield is 110 μ long and 64 μ wide, it is elongated with a rounded anterior margin. The paranal setae are inserted near the anterior margin of the anus, and their length is about the same as that of the postanal seta. About 19 pairs of setae lie on the ventral membrane. The peritreme reaches to the middle of coxa I.

The respective lengths of the legs (excluding pulvilli) are as follows : I—465 μ ; II—420 μ ; III—420 μ ; IV—540 μ. Coxa II bears the usual antero-dorsal spine, this is rather long and sharp, on the ventral side there is only a small wart-like projection but no spur. Coxa III carries two large spurs on the postero-ventral surface, the proximal spur being much bigger than the distal. The hind rim of coxa IV is serrated. Seventeen to nineteen deutosternal teeth are irregularly arranged in alternating rows of single teeth on both sides of the median line. The chelicerae are

Figs. 94–98. *Hirstionyssus ellobii spalacis* ssp. nov. Fig. 94, dorsum of female. Fig. 95, venter of female. Fig. 96, venter of male. Fig. 97, coxae II–IV of male. Fig. 98, coxae I–IV of female.



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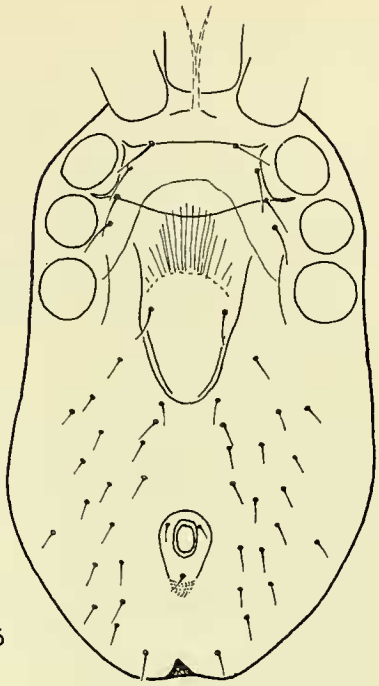

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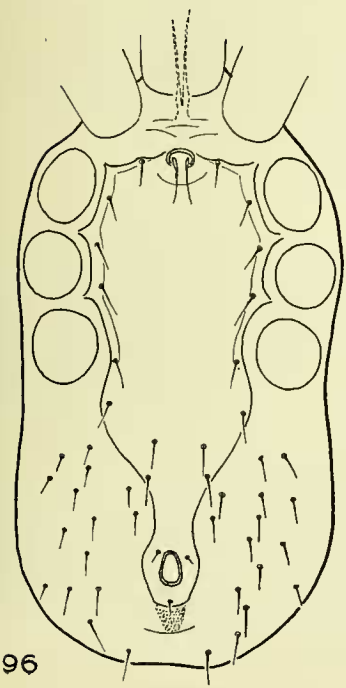

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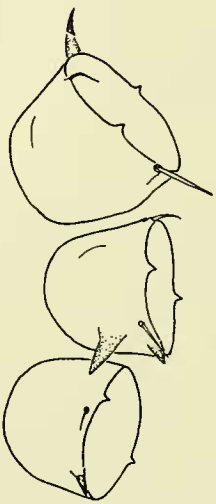

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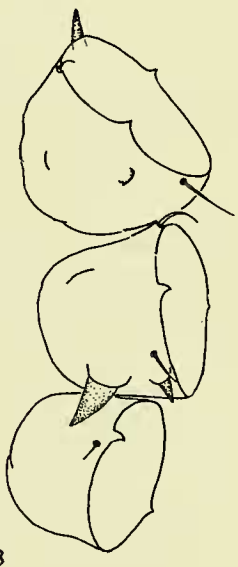

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long and edentate. The rostral setae are short, the anterior rostral seta being the longest of all gnathosomal setae.

Male (Text-figs. 96, 97). The dorsal shield is 480–495 μ long and 255–270 μ wide. It has well-pronounced shoulders and parallel sides, the posterior part of the shield ends in an obtuse angle. The chaetotaxy of the shield is essentially the same as in the female. The surface of the shield is granulated and the anterior setae are longer and stouter than the marginal setae on the posterior half. The holoventral shield bears 19 setae (including anal setae). This shield which has a granulated surface is violin-shaped. There is a slight constriction at the level of coxae IV and a second, much more marked constriction just in front of the anus. The arrangement of spurs on coxae II and III is similar to that in the female, but the serrated rim of coxa IV bears an additional spur postero-ventrally.

Hosts and localities. 4 ♂, 10 ♀—*Spalax ehrenbergi*, Zikhron Ya'aqov, 8.v.1954; 31 ♀—*S. ehrenbergi* (no locality), 22.iv.1954; 1 ♀—*Mus musculus*, Tivon, 22.ii.1956.

Notes. The Israel specimens have been compared with specimens recovered from *Ellobius talpinus* in U.S.S.R., determined by Dr. N. Bregetova, and were found to differ as follows: The proximal spur of coxa II in the Israel material measures about 45 μ in length, whereas the length of the spur in specimens from *E. talpinus* is only 20 μ in length. The shape of the shield is more elongated and less ovoid in the material from Israel, and the posterior margins of the shield form a much more acute angle. It is therefore considered that the Israel material belongs to a new subspecies. The subspecific name *spalacis* has been chosen as this mite is very common on the mole-rat (*Spalax*).

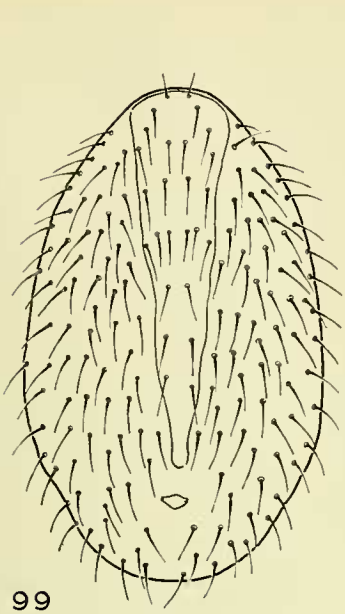
This mite has been recovered in large numbers from sucklings of *Spalax ehrenbergi* taken fron the nests. On these suckling mole-rats *Hirstionyssus ellobii spalacis* can be regularly found clustered in the axial and inguinal cavities, although this circumstantial evidence does not prove that *H. ellobii spalacis* is an active blood-feeder.

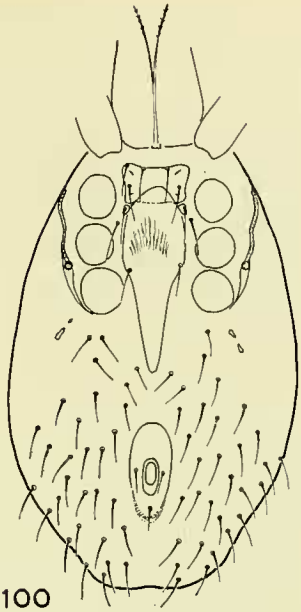
Allodermanyssus aegyptius (Hirst)

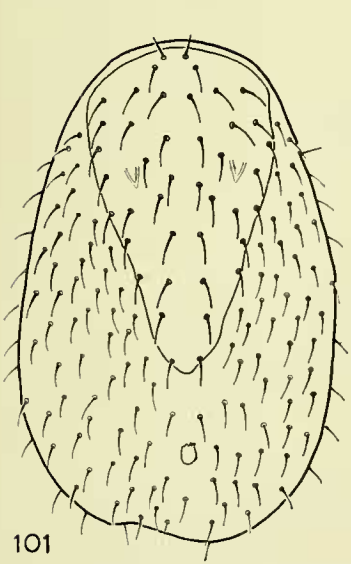
Dermanyssus (*Liponyssoides*) *aegyptius* Hirst, 1913.
Dermanyssus aegyptius Hirst, 1914.
Allodermanyssus aegyptius, Keegan, 1956.

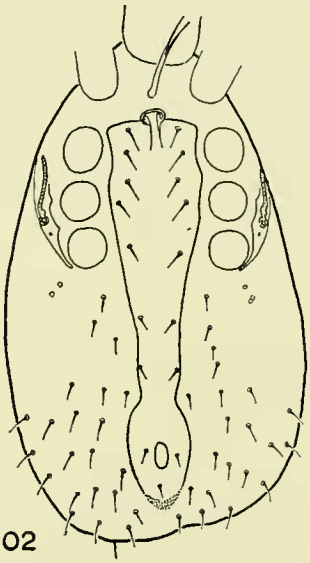
Female (Text-figs. 99, 100). The dorsal surface of the female is covered by two shields, a seta bearing anterior dorsal shield and a small, rudimentary pygidial shield without setae. The anterior dorsal shield (860 μ in length) is elongated and very narrow posteriorly. The shield bears 13 pairs of setae, similar in character to those on the adjacent membrane. The antero-lateral setae of the dorsal membrane are slightly pilose. The pygidial shield which is rather irregular in shape, is 42 μ long and 67 μ wide.

The translucent tritosternum is long and slender, its laciniae are pilose. The sternal shield is divided into the sternal shield proper which bears two pairs of sternal setae, and two small triangular platelets which bear the third sternal setae. The sternal shield proper is about rectangular in shape, 90 μ long (at mid-line) and 145 μ wide (at the level of the second setae). The anterior margin of the sternal shield is slightly concave, and the posterior margin is slightly convex.

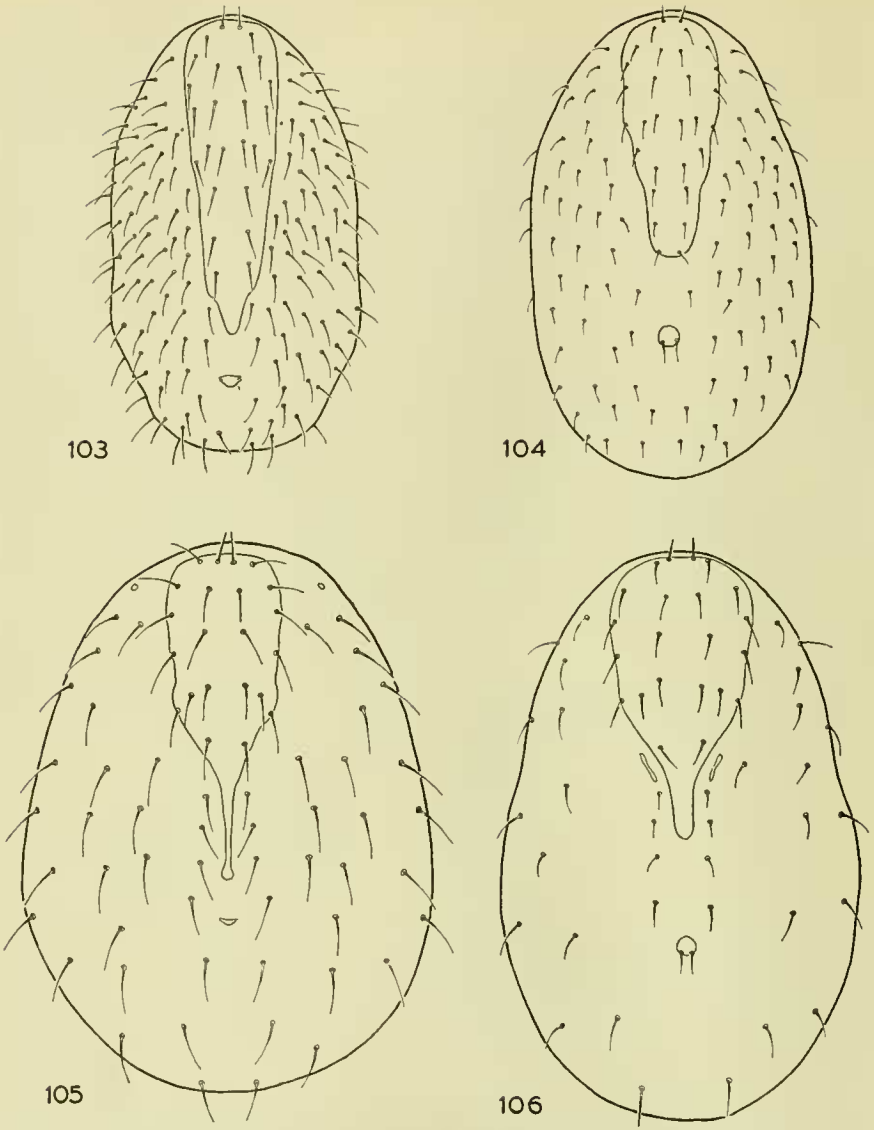








FIGS. 99–102. *Allodermanyssus aegyptius* (Hirst). Fig. 99, dorsum of female. Fig. 100, venter of remale. Fig. 101, dorsum of male. Fig. 102, venter of male.



FIGS. 103–106. Fig. 103, *Allodermanyssus aegyptius* (Hirst), dorsum of deutonymph. Fig. 104, *Allodermanyssys sanguineus* (Hirst), dorsum of deutonymph. Fig. 105, *A. aegyptius*, dorsum of protonymph. Fig. 106, *A. sanguineus*, dorsum of protonymph.

The genital shield is broad anteriorly and overlaps the sternal shield considerably. Posteriorly the shield is very narrow and projects considerably beyond coxa IV.

The anal shield is very elongated, it is 225 μ long and 150 μ wide, its anterior margin is rounded. The anal setae are all of approximately the smae length (approximately 58 μ). The peritreme reaches to the middle of coxa II.

The legs are very slender and long, their respective lengths (excluding pulvilli) being as follows: I—1,070 μ; II—870 μ; III—880 μ; IV—1,260 μ. Only very few (4–5 ?) deutosternal teeth are present and these are arranged in a single file. The capitular setae are the longest of all gnathosomal setae (approximately 90 μ).

Male (Text-figs. 101, 102). The anterior dorsal shield (495–540 μ in length) is almost triangular and broadest at the level of the second pair of legs. The shield bears 21 pairs of simple setae. The pygidial shield is irregularly shaped, it is 38 μ long and 38 μ wide. The holoventral shield of the male is very narrow and constricted in front of the anal portion, it bears 17 setae, including the anal setae. The paranal setae are inserted slightly anterior to the mid-line of the anus. Two pairs of small metapodal shields lie posteriorly to coxa II. The legs are very elongated and slender, as in the female. The peritreme is short and does not reach the middle of coxa II.

Deutonymph (Text-fig. 103). The anterior dorsal shield is narrow and elongated, tapering abruptly behind the last pair of setae and ending in a broader knob. The shield bears 13 pairs of simple setae. The pygidial shield is like that of the female. The wedge-shaped sternal shield bears only 3 pairs of setae, but 2 additional pairs flank the sides of the shield posteriorly. The shield projects only slightly beyond the posterior margin of coxa IV. The anal shield is elongated as in the female. The peritreme is short, scarcely projecting beyond the posterior margin of coxa II.

Protonymph (Text-fig. 105). The anterior dorsal shield has a very narrow handle-like projection posteriorly, the end of the handle being slightly broader and knob-like. The shield bears 11 pairs of simple setae (which are considerably longer and stouter than in the protonymph of *L. sanguineus*). The pygidial shield is short as in the female. The sternal shield does not project beyond the posterior margin of coxa IV, it bears 3 pairs of setae. The anal shield is elongated, with the anus situated at the posterior end of the shield. The peritreme is rudimentary.

Hosts and localities. All specimens were recovered from *Acomys cahirinus*, localities and dates being as follows: 1 pn, 1 dn, 1 ♀—Yotrata, 1.ii.1953; 1 dn—ditto; 1 ♂—Eyn Gedi, 15.iii.1953; 1 dn—ditto; 1 pn—ditto; 3 pn, 1 dn, 1 ♂—ditto; 2 pn, 1 dn—ditto; 11 pn, 2 dn—ditto; 1 pn—ditto; 3 pn, 1 ♂—ditto; 1 dn, 1 ♂, 1 ♀—ditto; 2 pn, 2 dn—Wadi Seyal, 5.iii.1954.

Notes. See notes of *A. sanguineus*. Keegan (1956) gives *Rattus rattus* and *Rattus norvegicus* as additional hosts of these species in Egypt. These two rodents are not found in the wild state in the southern desert of Israel to which the two *Allodermanyssus* species appear to be confined.

Allodermanyssus sanguineus (Hirst)

Dermanyssus (*Liponyssoides*) *sanguineus* Hirst, 1913.
Dermanyssus sanguineus Hirst, 1915.
Allodermanyssus sanguineus, Ewing, 1922.

Female (Text-figs. 107, 108, 109). The dorsum is partially covered by two shields, a main elongated anterior dorsal shield and a small rounded pygidial shield. The

anterior dorsal shield is 600–630 μ in length, very narrow and wedgr-shaped. The shield bears 15 (rarely 16) pairs of long setae. Setae *i*1 are shorter than the other setae on the shield and some of the antero-lateral setae are slightly pilose. The pygidial shield is ovoid, 77 μ long and 54 μ wide and bears 2 setae.

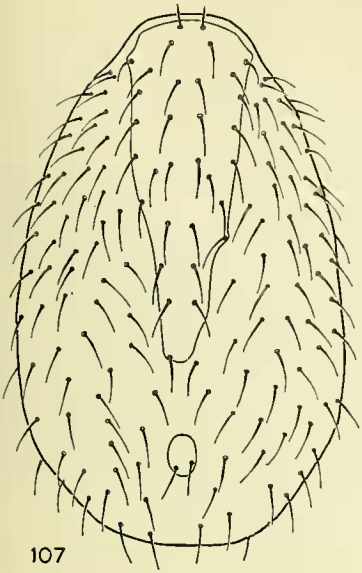
The tritosternum has a broad base and its narrow laciniae are sparsely feathered with short hairs. The sternal shield is 70–85 μ long (at mid-line) and 112–128 μ wide. The anterior margin of the shield is almost straight, with rounded corners,the posterior margin being slightly concave. The pores are very elongated ; the anterior pores are parallel to the anterior margin of the sternal shield while the posterior pores have a pronounced outward slant. The sternal setae are slender and elongated, and the setae of the first pair barely reach beyond the posterior margin of the shield. All the sternal setae and metasternal setae are of about the same length.

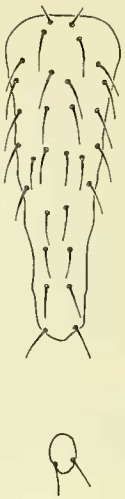
The genital shield is wedge-shaped, elongated and projecting backwards well beyond coxa IV. The genital setae are of about the same length as the metasternal setae. The anal shield is elongated and its anterior margin is round. The shield is 210 μ long and 100 μ wide. The paranal setae are generally inserted slightly below the mid-line of the anus, but sometimes at mid-line, these setae are slightly longer than the postanal setae. The peritreme extends to about the middle of coxa II.

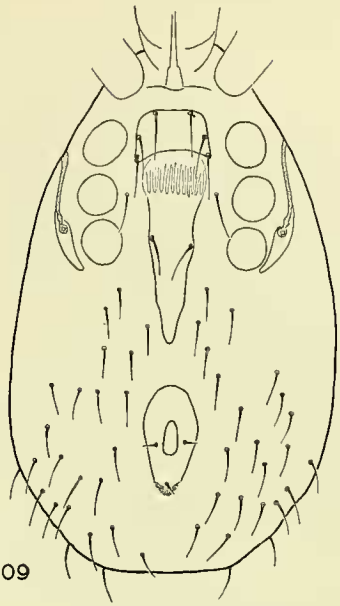
The legs are very long and slender, and their respective lengths (excluding pulvilli) are as follows : I—975 μ ; II–795 μ ; III—825 μ ; IV—1,035 μ. Approximately 14 deutosternal teeth are arranged in a single file. The internal posterior rostral setae are the longest of all the gnathosomal setae (approximately 65 μ).

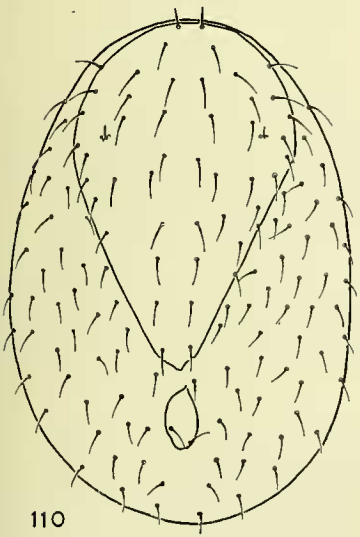
Male (Text-figs. 110, 111). The male of this species has been hitherto unknown (see notes). The dorsal surface is partially covered by 2 dorsal shields as in the female. The anterior dorsal shield which is much broader than in the female is broadest just behind the level of coxa II. Consequently the number of setae on the shield (22 pairs) is higher than in the female. The pygidial shield is elongated and less regularly shaped than in the female, it is 64–77 μ long and 26–42 μ wide in the two specimens examined. The sternito-ventral shield which is separate from the anal shield, is elongated and almost parallel-sided, it projects only slightly beyond the hind margin of coxa IV. The shield bears 5 pairs of setae and these are only slightly longer than the setae on the ventral membrane. Anteriorly the shield is flanked on each side by two small triangular shields. The anal shield is similar to that of the female. The legs are very long and slender, their respective lengths (excluding pulvilli) being as follows : I—700 μ ; II—570 μ ; III—560 μ ; IV—795 μ. The peritreme is very short and apparently reaches only to the middle of coxa III. The accompanying peritrematal shield appears to extend to the middle of coxa II. The chelicerae are elongated and very narrow and the very small deutosternal teeth are arranged in a single file.

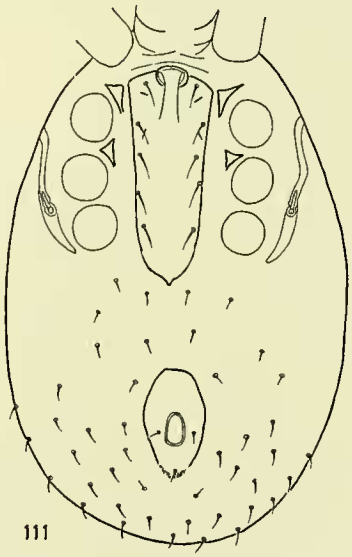
Deutonymph (Text-fig. 104). The dorsal surface is partially covered by an anterior dorsal shield and by a pygidial shield. Fifteen pairs of simple setae are inserted on the anterior dorsal shield which is 400–500 μ long. The pygidial shield bears two setae (it is 38–51 μ long and 32–38 μ wide). The sternal shield is wedge-shaped and its pointed end projects slightly beyond coxa IV. The shield bears 4 pairs of setae. The peritreme is very short and scarcely reaches the middle of coxa III.











FIGS. 107–111. *Allodermanyssus sanguineus* (Hirst). Fig. 107, female, showing asymmetrical dorsal shield. Fig. 108, female, normal dorsal shield. Fig. 109, venter of female. Fig. 110, dorsum of male. Fig. 111, venter of male.

Protonymph (Text-fig. 106). The dorsal surface is partially covered by the anterior dorsal shield and by the pygidial shield. The anterior dorsal shield is different in shape from that of the female and the deutonymph. It is rather broad in its main part, but behind the last pair of setae it tapers off into a narrow, handle-like part which does not bear setae. The anterior dorsal shield bears 11 pairs of simple setae. The length of the shield is approximately 285 μ. The small pygidial shield is similar to that of the deutonymph. The sternal shield bears 3 pairs of setae. It is wedge-shaped, broadest at the second pair of setae and tapering off into a pointed end behind the third pair of setae. Three pairs of setae are inserted on the ventral membrane anterior to the anal shield. The beginnings of a short peritreme are discernible.

Hosts and localities. 8 pn, 17 dn, 1 ♂, 4 ♀—*Acomys cahirinus* (six specimens), Wadi Seyal, 5.iii.1954; 2 dn, 1 ♂, 4 ♀—*Acomys russatus*, Mezada, 4.iii.1955.

Notes. In Hirst's paper (1914) describing some species of *Dermanyssus*, a description of what he thought to be the male of *D. sanguineus* is given, whereas the male of *D. aegyptius* is considered unknown. In the present study, males of both species have been found and compared. It has been found that the male described by Hirst as the male of *D. sanguineus* is actually the male of *D. aegyptius*. A comparison of the males of the two species shows that they differ distinctly in the characters of the dorsal and ventral surfaces.

Ornithonyssus bacoti (Hirst)

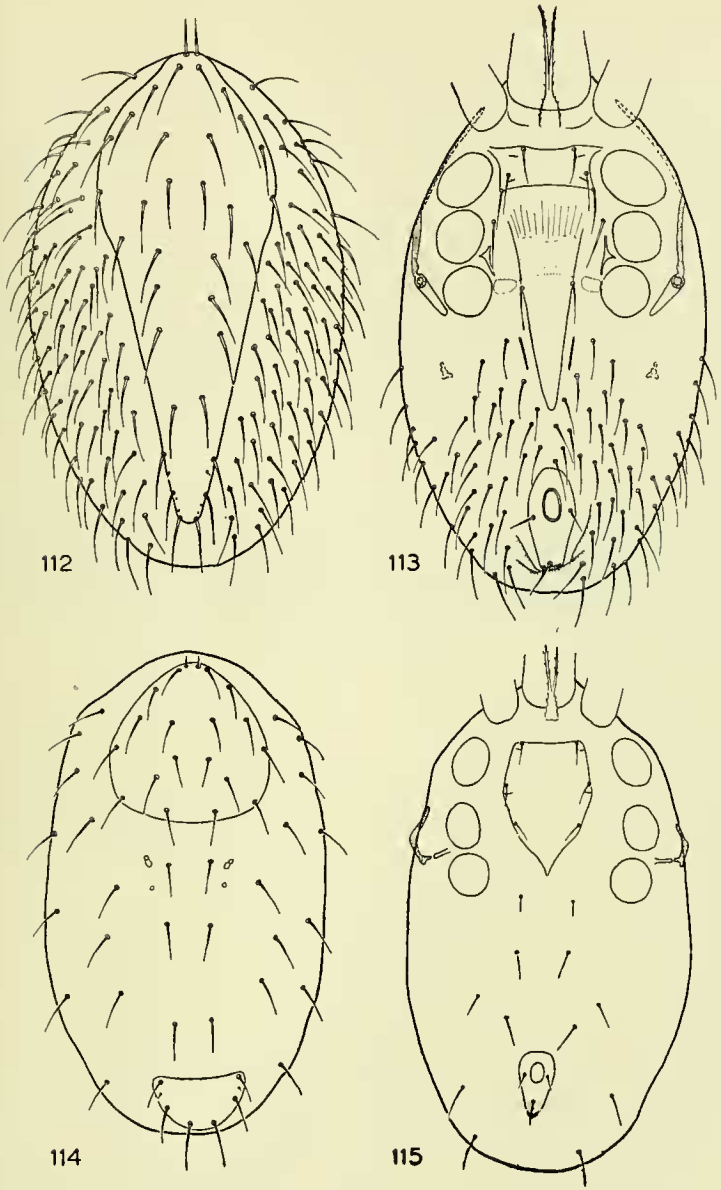
Leiognathus bacoti Hirst, 1913.
Liponyssus bacoti Hirst, 1920.
Bdellonyssus bacoti, Fonseca, 1941.
Macronyssus bacoti, Buitendijk, 1945.

Female (Text-figs. 112, 113). The dorsal shield is narrow and elongated, covering only a small part of the dorsal surface. The shield is 555–660 μ long and 225–240 μ wide at its widest part. It bears 17 pairs of simple elongated setae in addition to one pair of very small setae which are on the posterior margin.

The tritosternum is long, translucent with a feathered base and long, feathered laciniae. The sternal shield is 45 μ long (at mid-line) and 102 μ wide (at the level of the second setae). This shield is almost rectangular, but slightly wider at the anterior than at the posterior margin. The setae of the first pair which scarcely reach beyond the hind margin of the sternal shield, are slightly shorter than the other sternal setae and the metasternal setae.

The genital shield is narrow and pointed. A very narrow elongated shield lies on each side of the posterior part of the genital shield. Numerous setae are inserted on the ventral membrane. The anal shield is elongated, it is approximately 125 μ long and 65 μ wide, it is widest at the level of the paranal setae. The paranal setae are slightly shorter than the postanal seta, they are inserted posteriorly to the middle of the anus. The peritreme reaches to the middle of coxa I, and a narrow peritrematal shield is present.

The legs are slender and long, their respective lengths (excluding pulvilli) being as follows: I—510 μ; II—380 μ; III—360 μ; IV—510 μ. The chelicerae are



FIGS. 112–115. *Ornithonyssus bacoti* (Hirst). Fig. 112, dorsum of female. Fig. 113, venter of female. Fig. 114, dorsum of protonymph. Fig. 115, venter of protonymph.

elongated. A single file of 9 deutosternal teeth is present. The internal posterior rostral setae are the longest of the gnathosomal setae.

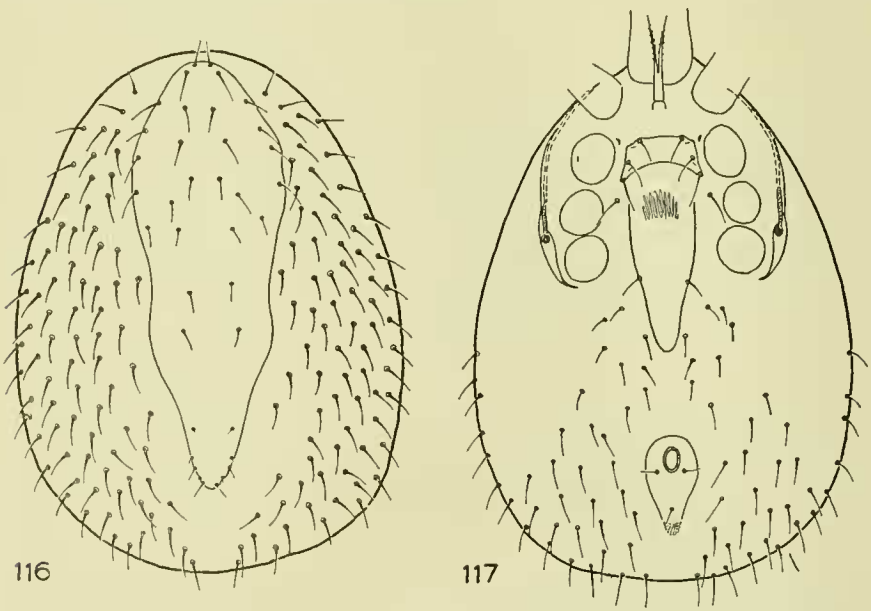
PROTONYMPH (Text-figs. 115, 116). The anterior dorsal shield is approximately 175 μ long and 175 μ wide, its posterior margin is convex. The shield bears 10 pairs of simple long setae, setae *i*1 being shorter than the other setae. The pygidial shield bears 3 pairs of simple elongated setae and one pair of very small setae. The sternal shield, which bears the usual 3 pairs of setae, is pointed at its posterior end and does not project beyond coxa IV. Four pairs of setae lie on the membrane between the sternal and the anal shields.

HOSTS AND LOCALITIES. 1 ♀—*Rattus rattus*, Akko (Dunes), 8.iv.1954; 1 ♀—*Acomys cahirinus*, Mishmar Ha'emeq, 28.x.1955; 2 pn—ditto; 8 pn, 2 ♀—Mishmar Ha'emeq, 28.ix.1956; 4 pn—*R. rattus*, Qishon, 16.vii.1957; 2 pn—*Apodemus mystacinus*, Barkai, 16.vii.1957; 1 ♀—ditto, Me'arat Karmel, 25.vii.1957.

NOTES. No deutonymphs have been found of this species, which is in agreement with the fact that in *O. bacoti* the deutonymph is non-feeding and moults within 24–36 hours (Baker *et al.*, 1956).

Ornithonyssus nitedulae sp. nov.

FEMALE (Text-figs. 116, 117). The dorsal shield is 615–660 μ long. The shield which is narrow and elongated is constricted in the middle. Nineteen pairs of setae are inserted on the shield, the setae on the posterior part being very short. The setae on the dorsal membrane are narrowly lanceolate.



FIGS. 116–117. *Ornithonyssus nitedulae* sp. nov., female. Fig. 116, dorsum. Fig. 117, venter.

The tritosternum is very delicate and translucent, the laciniae being apparently unfeathered. The sternal shield is 35 μ long (at mid-line) and 112 μ wide (at the level of the second pair of setae). Between the setae of the first pair the anterior margin of the shield is straight, but it slopes off at the corners. The posterior margin of the shield is concave. The anterior pores are horizontal, the posterior pores have an outward slant. The sternal setae increase in length from the first to the third pair. The metasternal setae are as long as the third sternal setae (approximately 65 μ).

The narrow genital shield, which bears one pair of setae, projects beyond coxa IV. The anal shield is elongated, it is 160 μ long and 85 μ wide with the anus near the anterior margin. The paranal setae are inserted near the posterior end of the anus, they are of the same length as the postanal seta. Numerous setae are inserted on the ventral membrane. The tubular portion of the peritreme apparently reaches only to the middle of coxa III, it is accompanied by a peritrematal shield which anteriorly reaches to the middle of coxa I, and posteriorly it approaches coxa IV. Coxa II has a strong sharp spur on its antero-dorsal side, it is not marginal.

The legs are fairly short and stumpy, their respective lengths being as follows: I—585 μ; II—465 μ; III—465 μ; IV—585 μ. The chelicerae are elongated, narrow and edentate. The ventral spur on the palpal coxa is prominent and the deutosternal teeth are arranged in a single file.

Hosts and localities. 6 ♀—*Dryomys nitedula*, Wadi Keren, 20.x.1957.

Notes. This species is obviously very near *Ornithonyssus dogieli* Breg. which was recorded from the same host (in Tadzhikistan). It can be easily separated from it by the shape and the chaetotaxy of the dorsal shield.

TABLE I. *The Host-parasite Relationships*

Acari \ Rodents	*Jaculus jaculus*	*Dryomys nitedula*	*Spalax ehrenbergi*	*Apodemus mystacinus*	*Apodemus sylvaticus*	*Rattus rattus*	*Mus musculus*	*Acomys cahirinus*	*Acomys russatus*	*Nesokia indica*	*Gerbillus dasyurus*	*Gerbillus gerbillus*	*Gerbillus allenbyi*	*Gerbillus pyramidum*	*Meriones tristrami*	*Meriones crassuss*	*Meriones sacramenti*	*Sekeetamys calurus*	*Cricetulus migratorius*	*Microtus guentheri*
Haemolaelaps androgynus											●									
H. andrógynus caluri																		●		●
Haemolaelaps glasgowi													●							
Haemolaelaps hirsti			●				★													
Haemolaelaps hirsthionyssoides														●			●			
Haemolaelaps inscultptus										○	○		●			●				
Haemolaelaps longipes										○						●				
Haemolaelaps ovalis															●	★				
Haemolaelaps centrocarpus												●	●	●						
Laelaps aconydis								●												
Laelaps agilis longispinosus					●															
Laelaps algericus							●													
Laelaps ebstreni																			●	●
Laelaps pachypus						●					○									
Androlaelaps marshalli									●											
Eulaelaps stabularis								●												
Haemogamasus horridus				●																
Hirstionyssus arcuatus																				●
Hirstionyssus craticulatus																				
Hirstionyssus ellobii spalacis			●																	
Allodermanussys aegyptius									●											
Allodermanyssus sanguineus									●											
Ornithonyssus bacoti				●					●											
Ornithonyssus nitedulae		●																		

● = common host. ○ = rare host. ★ = accidental host

SUMMARY

This paper deals with 24 species and subspecies of Laelaptid mites associated with rodents in Israel. The following new species and subspecies are described : *Haemolaelaps hirstionyssoides, Haemolaelaps ovalis, Laelaps acomydis, Ornithonyssus nitedulae, Haemolaelaps androgynus caluri, Laelaps agilis longispinosus,* and *Hirstionyssus ellobii spalacis.*

Descriptions of the hitherto unknown males of *Hirstionyssus craticulatus* Keegan, 1956, and of *Allodermanyssus aegyptius* (Hirst) 1913, are included.

Laelaps ekstremi Zachv., 1948, synonymized with *Laelaps jettmari* Vitzthum, 1930 by Bregetova (1956), is considered a valid species. *Haemolaelaps aegyptius* Keegan, 1956, is synonymized with *Haemolaelaps longipes* Breg., 1952, and *Laelaps arvalis* Zachv., 1948, is synonymized with *Laelaps pachypus* C. L. Koch, 1839.

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REFERENCES

Baker *et al.* 1956. *A Manual of Parasitic Mites.* Tech. Publ. Nat. Pest Control Ass., Inc. New York.

Berlese, A. 1910. Lista di nuove species e nuovi generi de Acari. *Redia,* **6** : 262–271.

—— 1911. Acarorum species novae quindecim. *Ibid.* **7** : 429-435.

—— 1920. Centuria quinta di Acari nuovi. *Ibid.* **14**: 143–195.

Bregetova, N. G. 1952. New species of mites of the genus *Haemolaelaps* (Gamasoidea Laelaptidae) parasitizing rodents. *Zool. Zh.* **31** : 866–874.

—— 1956. *Gamasid Mites (Gamasoidea).* Acad. Sci. U.S.S.R., Moskva.

Canestrini, G. & R. 1882. I gamasi italiani. *Atti. Soc. Ven.—Trent. Sci. Nat. Padova,* **8** : 3–82.

Costa, M. 1958. The ectoparasites of mammals and birds in Israel. Ph.D. thesis (the Hebrew University, Jerusalem. Unpublished).

Evans, G. O. 1957. An introduction to British Mesostigmata (Acarina) with keys to families and genera. *J. Linn. Soc.—Zool.* **43** : 203–259.

Ewing, H. E. 1925. New parasitic mites of the genus *Laelaps. Proc. ent. Soc. Washington,* **27** : 1–7.

—— 1933. New genera and species of parasitic mites of the superfamily Parasitoidea. *Proc. U.S. nat. Mus.* (2971), **82** (30) : 1–14.

Fonesca, F. 1941. Posicao do genero *Liponyssus* Kolenati em face das especies tropicals, seu desdobramento eu novos generos. *Ciencia Mèx.* **2** : 262–265.

Gratz, N. G. 1957. A rodent ectoparasite and murine typhus survey in Haifa port. *Bull. Res. Counc. Israel,* **6** (E) : 178–181.

Hirschmann, W. 1957. *Gangsystematik der Parasitiformes. Teil* 1*—Rumpfbehaarung und Rueckenflaechen. Schriftenreihe fuer vergleichende Milbenkundse.*

Hirst, S. 1913. On three new species of gamasid mites found on rats. *Bull. ent. Res.* **4** : 117–124.

HIRST, S. 1915. On some new acarine parasites of rats. *Bull. ent. Res.* **6** (2) : 183–190.
—— 1915*b*. On the parasitic Acari found on the species of rodents frequenting human habitations in Egypt. *Ibid.* **5** : 215–229.
—— 1920. Species of Arachnida and Myriapoda injurious to man. *Econ. Ser. British Museum (N.H.)* **6** : 1–58.
—— 1923. On some new or little known species of Acari. *Proc. zool. Soc. London*, 971–1000.
—— 1925. Descriptions of new Acari, mainly parasitic on rodents. *Ibid.*, Pt. 1 : 49–69.
JAMESON, E. W. & KEEGAN, H. L. 1952. Parasitic mites found on small mammals in Japan and Korea. *Off. Chief Surg. Far East Command*, 14 pp.
KEEGAN, H. L. 1951. The mites of the subfamily Haemogamasinae (Acari : Laelaptidae). *Proc. U.S. nat. Mus.* **101** : 203–268.
—— 1956. Ectoparasitic laelaptid and dermanyssid mites of Egypt, Kenya and the Sudan, primarily based on Namru 3 collections, 1948–1953. *J. Egyp. publ. Hlth. Ass.* **31** : 199–272.
KOCH, C. L. 1835–44. *Deutschlands Crustaceen, Myriapoden und Arachniden. Ein Beitrag zur deutschen Fauna. Herausgegeben von Herrich-Schaeffer.* 40 pts. Regensburg.
LANGE, A. B. 1955. Gamasid mites (general review ; genus *Laelaps* and *Oryctolaelaps*), pp. 217–243, 324–340. *In : Acarina of the Rodent Fauna of U.S.S.R.*
MICHAEL, A. D. 1892. On the variation in the internal anatomy of the gamasinae. *Trans. Linn. Soc. Lond*, **5** : 281–324.
OUDEMANS, A. C. 1936. *Kritisch Historisch Overizcht der Acarologie.* Leiden, pt. 3a, pp. 241–250.
STRANDTMANN, R. W. 1949. The bloodsucking mites of the genus *Haemolaelaps* (Acarina : Laelaptidae) in the United States. *J. Parasit.* **35** : 325–352.
STRANDTMANN, R. W. & WHARTON, G. W. 1958. *Manual of Mesostigmatic Mites.* The Institute of Acarology. Contr. No. 4.
TIPTON, V. J. 1960. The genus *Laelaps* with a review of the Laelaptinae and a new subfamily Alphalaelaptinae (Acarina : Laelaptinae). *Univ. Calif. Publ. Ent.* **16** (6) : 233–327.
TRÄGÅRDH, I. 1923. Contributions towards the comparative morphology and phylogeny of the Parasitidae (Gamasidae). *Ark. Zool. Stockholm*, **7** : 1–24.
TURK, F. A. 1945. Notes on and descriptions of new and little known British Acari. *Ann. Mag. nat. Hist.*, ser. 2, **12** : 785–820.
VITZTHUM, H. 1930. Milben als Pestträger ? Ein Beitrag zu den Untersuchungen der Mandschurischen Peststudienkommission in Harbin. *Zool. Jahrb., Jena*, **60** (3–4) : 381–428.
ZACHVATKIN, A. A. 1948. The taxonomy of the genus *Laelaps* (Acarina : Parasitiformes) and problems of its epidemiological significance. *Parasit. Comp. Acad. Sc. U.S.S.R.*, **10** : 51–76.
ZUMPT, F. 1950. Descriptions of two new *Laelaps* species from South Africa with a key to the Ethiopian species of the genus (Acarina : Laelaptidae). *S. Afr. j. med. Sci.* **15** : 77–82.
—— 1950*b*. Notes on parasitic mites. I. Some remarks on the family Laelaptidae (sensu Vitzhum, 1943) with descriptions of three new species from African rodents. *Parasitology*, **40** (3–4) : 289–303.
ZUMPT, F. & PATTERSON, P. M. 1950. The Ethiopian species of *Hypoaspis* subgen. *Androlaelaps* Berles (1903), with description of a new species. *S. Afr. j. med. Sci.* **15** : 67–74.